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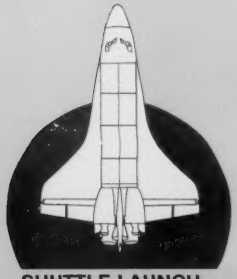

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INTRODUCTION

Scientific and Technical Aerospace Reports (STAR) is a major component of a comprehensive National Aeronautics and Space Administration information system covering aeronautics, space, and supporting disciplines. *STAR* is issued on the 8th and 23rd of each month and announces current publications of the following types:

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Subject scope of *STAR*, *IAA*, and *On-Going Research Projects* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications *and navigation; aircraft design, testing and performance;* aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research *and support facilities (air).*

For related information see also *Astronautics.*

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Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

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03 AIR TRANSPORTATION AND SAFETY 994

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 998

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For related information see also *17 Spacecraft Communications, Command and Tracking* and *32 Communications*.

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For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

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For related information see also *Aeronautics*.

12 ASTRONAUTICS (GENERAL) N.A.

For extraterrestrial exploration see *91 Lunar and Planetary Exploration*.

13 ASTRODYNAMICS 1011

Includes powered and free-flight trajectories; and orbit and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) N.A.

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

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16 SPACE TRANSPORTATION 1013

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For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING 1013

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For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 1013

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For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

19 SPACECRAFT INSTRUMENTATION 1014
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27 NONMETALLIC MATERIALS 1034
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Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.
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Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1128
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1129
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1129
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS 1131
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE 1131
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1131
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1132
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 1133
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 1133
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS 1133
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION N.A.
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL 1134

Note: N.A. means that no abstracts were assigned to this category for this issue.

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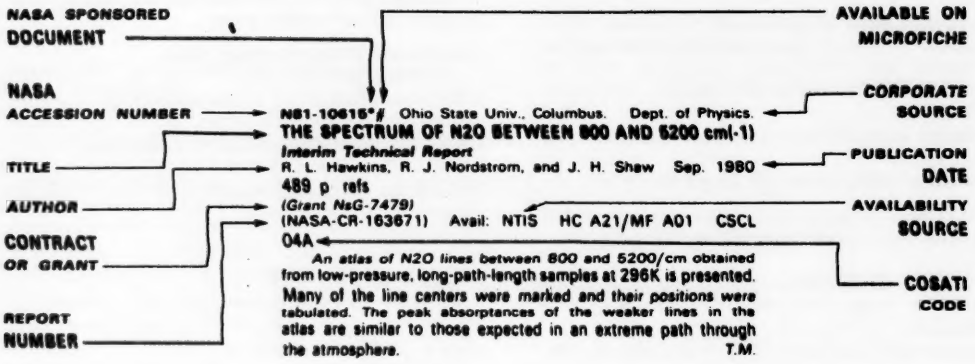
TYPICAL CITATION AND ABSTRACT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N81-10615*# Ohio State Univ., Columbus. Dept. of Physics.
THE SPECTRUM OF N2O BETWEEN 800 AND 5200 cm(-1)
Interim Technical Report
R. L. Hawkins, R. J. Nordstrom, and J. H. Shaw Sep. 1980
489 p refs
(Grant NsG-7479)
(NASA-CR-163671) Avail: NTIS HC A21/MF A01 CSCL
04A
An atlas of N2O lines between 800 and 5200/cm obtained from low-pressure, long-path-length samples at 296K is presented. Many of the line centers were marked and their positions were tabulated. The peak absorptances of the weaker lines in the atlas are similar to those expected in an extreme path through the atmosphere.
T.M.

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, EXPEDIENT SNOW AND ICE ROADS AND LANDING FIELDS

P.R. Johnson, U.S. Dept. of Defense, Army, Corps of Engineers, Cold Regions Research & Engineering Lab., *Bldg. 4070, Fort Wainwright, Alaska* 99703 (DA0D8149)

To evaluate and improve the effectiveness of roads and landing fields built in cold regions of snow and ice and evaluate their impact on the underlying soil and vegetation.

Work will be continued on methods of compacting and hardening packed snow and snow collection techniques. Ice aggregate roads, roads constructed of ice pieces and provided with an ice wear surface, will be examined and observed. An extensive program of snow and ice roads in northwestern Alaska, funded by the U.S. government and constructed and used by Husky Oil, LT. In a large-scale oil exploration program, will be observed, monitored and evaluated.

SUPPORTED BY U.S. Dept. of Defense, Corps of Engineers, Cold Regions Research & Engineering Lab.

1.0002, ROTOR ACOUSTIC RESEARCH

I.C. Statler, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Aeromechanics Lab., *Moffett Field, California* 94035 (DA0C5003)

The objective is to make maximum utilization of the information inherent in the radiated aerodynamically generated noise signature of rotors obtained by the newly developed in-flight noise measurement technique. These measurements provide noise pressure signals undistorted by reverberation, doppler shift and other normally prevalent signal distortion mechanisms. These research efforts should provide the understanding of the noise generation mechanisms necessary to develop relatively simple mathematical analysis which can be used for rotor noise source and radiation pattern prediction.

A combined experimental theoretical effort will be followed utilizing tools developed to separate the noise generation mechanisms and allow concentrated effort to solve the complex problems in a step by step fashion. The first effort will be to define the impulsive noise generation mechanism and provide theoretical prediction capability. The second phase will concentrate on the blade vortex interaction noise and determine influence of rotor blade geometric parameters on rotor noise. Model rotor experimental efforts will utilize the laser velocimeter and other techniques such as Schlieren and shadowgraph to verify flow field disturbance patterns.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Aeromechanics Lab.

1.0003, HUMAN FACTORS ENGINEERING IN SUPPORT OF ARMY AVIATION

C.A. Fry, U.S. Dept. of Defense, Army, Army Materiel Development & Readiness Command, Human Engineering Lab., *Aberdeen Proving Ground, Maryland* 21005 (DA0C4955)

To devise means of simplifying helicopter crewstation through effective control/display integration for enhancing mission performance in night, terrain flying operations. Establish human performance criteria for performing aircraft maintenance in the forward area under night conditions.

Design parameters will be established for optimizing the interaction of the aircrew with the helicopter through a process of analysis, mock-up simulation, and flight test. The major problems to be addressed are control/display arrangement in the cockpit, CRT integration, symbology parameters, navigational accuracy, communication simplification, target hand-off and aircraft control simplification. Maintenance tasks will be analyzed to ascertain potential for simplification and the value of tactile cues for night, forward area operations. A focal point of cockpit instrumentation will be established to insure sound integration of all equipment which interfaces with the crew.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Human Engineering Lab.

1.0004, VATOL FIGHTER STUDY

C. Martin, U.S. Dept. of Defense, Navy, Naval Ship Research & Development Center, Aviation & Surface Effects Dept., *Bethesda, Maryland* 20084 (DN878681)

To quantify the pilot performance required to fly vertical attitude takeoff and land (VATOL) aircraft, and the performance potential of this type aircraft in fighter/attack missions.

3-DOF and 6-DOF simulations will be made of the control system in the critical takeoff and landing modes. Performance predictions of conceptual aircraft will be made. Preparations for 6-DOF, moving base simulation will be made. Investigation of potential research aircraft.

SUPPORTED BY U.S. Dept. of Defense, Navy, David W. Taylor Naval Ship Research & Development Center

1.0005, AERODYNAMICS RESEARCH

T. Tai, U.S. Dept. of Defense, Navy, Naval Ship Research & Development Center, Aviation & Surface Effects Dept., *Bethesda, Maryland* 20084 (DN678328)

Conduct an analytical and experimental research program to identify attractive aerodynamic techniques for improving the performance of advanced Navy aircraft. Studies will include the development of theoretical methods to determine the viscous and interference drag of three-dimensional bodies, and transonic flow with strong shock wave.

A. 3-D drag - in subsonic case, the skin friction over a 3-D body will be determined by applying proper axisymmetric boundary layer solution along a streamline and summing up over the whole body surface. Equations for determining streamline pattern over 3-D general bodies will be formulated and coded. Interference drag will be evaluated by considering the effects of cross flow and flow separation. In supersonic case, existing 3-D techniques will be identified. Adaption and necessary modification of the technique will be pursued for applicability to advanced Navy aircraft. B. Transonic airfoil - experimental

verification of an advanced airfoil previously theoretically derived under the present work unit for transonic buffet control will be carried out by testing a representative model. The experimental program will be conducted in cooperation with NASA/Ames. A new theoretical approach using the method of integral relations embedded infinite difference grid field will be taken to solve the mixed flow with strong shock wave.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0006, BOLTED FIELD REPAIR OF COMPOSITE STRUCTURAL COMPONENTS

J. Watson, McDonnell Douglas Corp., *P.O. Box 516, St. Louis, Missouri* 63166 (DN981067; N62269-78-C-0272)

To develop and demonstrate bolted field repair techniques for composite monolithic skins with damage in the area of the substructure. To provide simplified composite repair methods for structures applicable to emerging Navy aircraft which can be performed by organizationl level personnel with minimal special training and logistic support. This work is in support of work unit ZA601, aircraft technology, agency accession no. DN 681080.

Various designs will be analyzed and the most promising will be selected for fabrication and testing. Damages of up to 4 inch diameter in skins of skin thicknesses of up to 1/2 inch will be investigated. Included among the specific damage areas to be studied are the torque box skin adjacent to spars and ribs, and skin with associated damage to the substructure cap and skin attachment elements. Both conventional metal substructure and composite sine wave substructure will be considered. In all cases, the designs will be limited to repairs which can be performed in the field. Repair concepts will be designed so that they can sustain a gross strain level in the repaired area of more than 4000 micro in./in. while restoring the original stiffness. In addition, the repair will enable the structure to retain a 150(DLL) internal pressure capability. Additional constraints such as outside access only, relaxed tolerance for field capabilities, minimal external protrusion and fuel containment will also be considered. Static tension tests and internal pressure tests will be performed on fabricated specimens to verify the selected designs and procedures.

SUPPORTED BY U.S. Dept. of Defense, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate

1.0007, GENERATION AND VISUALIZATION OF TECHNIQUES FOR LARGE SCALE VORTEX STRUCTURES

H.C. Curtiss, Princeton University, School of Engineering & Applied Sciences, Dept. of Mechanical & Aerospace Engineering, *Box 430, Princeton, New Jersey* 08540 (NAG 1-108)

SUPPORTED BY U.S. National Aeronautics & Space Admin., *Langley Research Center*

1.0008, DEVELOPMENT AND VALIDATION OF AN INPUT - OUTPUT MODEL OF GENERAL AVIATION AIRCRAFT FUEL EFFICIENCY

L.M. Sweet, Princeton University, School of Engineering & Applied Sciences, Dept. of Mechanical & Aerospace Engineering, Box 430, Princeton, New Jersey 08540 (NAG 3-110)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

1.0009, AIRCRAFT-SHIP EQUIPMENT STUDIES

R. Black, U.S. Dept. of Defense, Navy, Naval Air Engineering Center, *Lakehurst, New Jersey* 08733 (DN096102)

In order to optimize V/STOL takeoff/landing operations, investigations wil be performed on the takeoff and landing interfaces between V/STOL aircraft and their projected platforms and to provide detailed studies of their potential problem areas. The following evaluations and analyses will be conducted: (1) candidate tracking systems; (2) pilot data related to approach profiles, information sources, visual ranges and levels and types of data; (3) aircraft deck handling simulation; (4) conceptual studies for emergency recovery of V/STOL aircraft; (5) development of a baseline of V/STOL aircraft, interface equipment and ship data.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0010, EFFECTS OF DRIVING GAS TEMPERATURE ON EJECTOR PERFORMANCE

R. Dejneka, U.S. Dept. of Defense, Navy, Naval Air Propulsion Test Center, 1440 Pkwy. Ave., Trenton, New Jersey 08628 (DN796800)

Determine the effect of driving gas temperature on ejector performance. Thrust augmenting ejectors appear to have a good potential for V/STOL and other low speed propulsion application.

A low volume ejector model which was developed by the flight dynamics research corporation will be tested at the Naval Air Propulsion Test Center (NAPTC) with driving gas at ambient, 400 and 800 F. Testing will be conducted at sea level, static conditions. Measurements will include: thrust, driving gas flows, and diffuser exit temperature and velocity profiles.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0011, ROTOR NOISE ANALYSES AND COMPARISON TO EXPERIMENTS

A.R. George, Cornell University, Ithaca Campus, School of Engineering, Dept. of Mechanical & Aerospace Engineering, 242 Carpenter Hall, Ithaca, New York 14853 (NAG 1-107)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0012, STUDY OF AIRFOILS FOR PROPELLER APPLICATION (ACOUSTICS/PERFORMANCE)

K.D. Korkan, Ohio State University, Columbus Campus, School of Engineering, Dept. of Aeronautical & Astronautical Engineering, 190 N. Oval Dr., Columbus, Ohio 43210 (NAG 3-118)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

1.0013, QUIET PROPELLER CONCEPT EVALUATION

R.M. McGregor, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF451910)

The objective of this program is to evaluate the noise characteristics of various tail rotor configurations to determine the noise reduction potential of various new designs. Variables to be investigated include number of blades, blade to hub phasing angles and blade length.

This exploratory research program is divided into three phases as follows phase I - analytical prediction this phase consists of the development of analytical techniques to predict the performance and acoustic characteristics of the various tail rotor configurations under consideration. The prediction programs will then be used to select the final test configurations. Phase II - experimental verification this phase consists of the experimental verification of predicted performance and acoustic characteristics utilizing the propeller acoustics static test facility. Static performance and near-field acoustic data will be acquired for representative configurations. Phase III - correlation this phase consists of a comparison of the results acquired during phases I and II, modification of the prediction methods developed during phase I where necessary and development of design procedures for reducing propeller and rotor noise.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0014, CRF FLOW QUALITY INVESTIGATION

R. Rivir, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF460540)

The primary objectives of this program are to determine the steady-state and dynamic distortion levels within the test chamber and the compressor bell-mouth of the Compressor Re-

search Facility (CRF) and to develop techniques to reduce these levels to acceptable values.

A series of tests are being carried out on a one-tenth scale model of the CRF using global mach number scaling with flow control elements employing Reynolds number similarity. Current and planned distortion tests involve parameters such as pressure, temperature, velocity, and flow direction.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0015, COMBUSTION SYSTEM REMOTE MEASUREMENTS

W.M. Roquemore, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF458220)

The objective of this program is to apply instrumentation which can measure temperature and specie concentration within chemically reactive zones of practical combustion devices.

Previous investigations have substantiated the feasibility of catalytic combustion at conditions simulating high-power operation of a gas turbine engine. This program will expand the data base for catalytic combustion in both low- and high-power modes through experimental investigations conducted in Room 20, Bldg 18C (see work unit 30480542). The ability of a catalyst to ignite and promote the combustion of a fuel/air mixture in an afterburner will be experimentally investigated in a J85 gas turbine engine mounted on Test Stand C, Bldg 71A (see work unit 30660532). To expand the basic knowledge of catalytic combustion processes, a fundamental research program will investigate the surface reactions on a catalytic flat plate in a combustion tunnel installed in Room 20, Bldg 18C (see work unit 30480542).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

1.0016, ANALYSIS DEVELOPMENT FOR DYNAMICS DATA REDUCTION

P.G. Bolds, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF139060)

This work unit supports the functions of the vibration and aeroelasticity facility for providing analysis of dynamics data. The broad problem is to provide state-of-the-art capabilities required for the recovery, analysis, and presentation of dynamics data which describe the operating environment of military flight vehicles and assess the accuracy of analytical prediction methods. The objective of this work unit is to integrate hardware to increase data recovery capabilities and to develop software for the analysis system that will advance the existing analysis and graphics capabilities. This will result in improved performance and advanced capabilities in the analysis of vibration and acoustic problems that occur during military operations.

The dynamics data analysis process consists of four parts- (1) data recovery and analog analysis, (2) analog-to-digital conversion, (3) digital analysis, and (4) graphic data presentation. The capabilities in the data recovery and a/d conversion areas will be increased by optimizing and upgrading the existing system components and by integrating new hardware into the system. The data analysis and graphics capabilities will be advanced by developing software and digital processing techniques to apply more sophisticated analysis procedures and to provide more graphic data presentation formats to increase the overall interpretability of the analysis results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0017, ENGINE SIMULATION FOR STORED ENERGY MANAGEMENT FUNCTION OF FLIGHT COMMAND COMPUTER FOR FIGHTER AND BOMBER AIRCRAFT

I.A. Carnegis, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF124830)

Advanced Air Force bombers and fighters are outpacing mission planning and control techniques such that the combat time becomes limited or the system grows in takeoff gross weight (TOGW) to meet combat requirements. New techniques and approaches are needed to properly manage the total stored energy of the air vehicle to assure an effective time for combat for a reasonable TOGW. Complete dynamic engine simulation is needed as an input to aircraft system simulation to develop energy management concepts and techniques. The objective of this effort is to develop a suitable engine simulation program of acceptable computer core capacity that can be integrated into a hybrid computer for energy management analysis.

This effort will evaluate the sensor concept including subscale development and evaluation of performance and environmental problems. A breadboard unit will be designed and built for laboratory demonstration and temperature readout of the gas temperature-density sensors. This unit, which will be operated over simulated gas turbine pressure and temperature ranges to determine performance, will generate sufficient data to permit design of a unit for an operating gas turbine engine.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0018, DEVELOPMENT OF MECHANICAL SYSTEMS FOR EXTENDING TECHNOLOGY OF AERODYNAMIC GROUND TESTING

J.M. Hample, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF141570)

The severity and complexity of the effect of the aerodynamic and thermodynamic environments on military vehicles increases as more stringent performance requirements are demanded. Consequently, new materials and configurations must be developed to negate the effect of the new requirements. Aerodynamic test facilities must be continually improved to provide the changing environment in which the performance of these new materials and configurations can be verified in a cost effective, timely manner. The objectives of this program are to develop and implement new technologies associated with fluid precessing systems, mechanical and structural containment, model support and articulation systems, and improving effectiveness, reliability and maintainability of aerodynamic ground test facilities.

Use in-house capability supplemented by engineering consultation and contacts on specific programs requiring unusual talents, expertise and hardware not available in-house. New techniques and hardware will be evaluated and applied to new and existing systems and facilities. Performance will be measured in terms of cost effectiveness, manpower requirements and the effect on the environment as well as applicability to current and anticipated problems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0019, COMPUTATIONAL AERODYNAMICS

W.L. Hankey, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF144650)

This work supports the A.F. Flight Dynamics Laboratory function of extending the technology base in aeromechanics. A deficiency exists in the ability to efficiently compute 3-D flow fields. The objective of this investigation is to develop three-dimensional numerical methods applicable throughout the flight corridor to solve governing differential equations of fluid mechanics. The current design technique for developing a new USAF system requires approximately 20,000 wind tunnel test hours, $50 million, and takes four years to accomplish. Use of numerical methods in the various design phases can dramatically shorten this cycle.

In the past decade remarkable advances have occured in the numerical computation of fluid flows. Advances in both computation methods and computer hardware have made this progress possible. The approach will be to develop numerical codes to efficiently solve various forms of the Navier-Stokes equations on the advanced computers based upon the advances accomplished under work unit 2307N418.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0020, MECHANICAL INSTRUMENTATION AND TEST ARTICLE DEVELOPMENTS
R.R. Heck, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF141550)

The design and performance of advanced military flight vehicles, manned re-entry and ballistic missiles can be seriously affected by the aerodynamic characteristics and the flow field surrounding these vehicles. This influence can be validated by testing these vehicles in aerodynamic ground test facilities. The problem is one of precision measurement of such aerodynamic parameters, from these facilities and test models, as force, moment, pressure, temperature and heat transfer rates. This effort is to develop new techniques for model and instrumentation system designs, fabrication and utilization to provide cost effective methods to produce accurate aerodynamic test data. Improved aerodynamic ground test capability will provide for more timely and cost effective development of advanced military flight vehicles and hardware.

Analytical and experimental studies will be made of present techniques to compare and evaluate factors to improve reliability, accuracy and system response. Test model inspection, utilizing a 3-axis measuring machine and computerized data reduction techniques will be further developed to increase data accuracy and reduce the time to obtain the data. Low cost model design and fabrication techniques will be investigated. Specialized instrumentation will be developed for the nine inch advanced transonic wind tunnel test section development program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0021, INTEGRATED CONTROL CONCEPTS DEVELOPMENT
S.J. Larimer, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF144630)

Military aircraft are becoming extremely sophisticated and complex in that the increased number of command, communication and control devices required to pilot military aircraft reduce the pilot's effectiveness to fly such missions. The objective of this effort is to develop and expand the existing concepts of integrated control and to identify and pursue new approaches to ensure that the pilot/vehicle system is integrated effectively using the latest processing technology. This effort will provide identifiable research goals to reduce the complexity of military aircraft that can provide future cost savings and make truly integrated control systems a reality. The mission to be supported is FG04A, control system architecture.

To provide a systematic development of integrated digital flight control concepts, a two-phase approach will be taken. Phase one will involve an analysis of current control integration efforts to determine common denominators, identify underlying concepts, and define specific areas where additional work is needed. Phase two will take this unified integrated control concept and pursue several of the specific areas identified in phase one. Each area selected will be accomplished either through in-house efforts or the work of a contracted expert.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0022, DYNAMIC DERIVATIVE PREDICTION AND CORRELATION
R.J. Mattes, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF143640)

This work unit supports TP03, flight control, and major thrust FG02D3, aircraft stability and control prediction. Specifically, it addresses the problem of dynamic stability (damping) derivative prediction. The objective of this effort is to evaluate current methods for predicting damping derivatives and to develop and verify a method for predicting derivatives more accurately using experimental wing pressure data. The output of this effort will make it possible to more accurately predict the dynamic characteristics of an aircraft from wind tunnel data early in the design process.

Wing pressure data from the F-111/TACT program will be used in this program. These data will be used in a computer program that calculates the deformed wing contribution to the damping derivatives. The output will be compared with flight test and wind tunnel extracted derivatives. The program will be modified as appropriate to achieve accurate results and the final results will be documented.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0023, LAMINATED WING STRUCTURES
J.B. Monfort, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF140090)

There is a continuing need to reduce costs and improve the structural efficiency of advanced military aircraft. Conventional design and construction techniques have been virtually pushed to their limits, with further improvements dependent almost entirely upon development of new alloys and material systems. The objective of this effort is to evaluate innovative design and fabrication techniques wherein additional system advantage can be achieved through laminating aluminum sheet by adhesive bonding to reduce acquisition and life cycle costs concurrently with weight savings and increased damage tolerance of primary airframe structure. The combination of economic and performance benefits realizable from improved airframes will provide the Air Force with a valuable tool for accomplishing the assigned mission with critical resources.

The Air Force Flight Dynamics Laboratory and the Air Force Materials Laboratory are jointly sponsoring contract F33615-75-C-5178 with General Dynamics/Fort Worth, MASIS accession number 678180, to design, fabricate and evaluate an adhesively bonded, laminated aluminum stub wing box based on the F-16 design criteria. As an integral part of this program three such wing boxes will be tested by the AFFDL, with nondestructive evaluation support from AFML, at Wright-Patterson AFB for static strength, fatigue and damage tolerance. All data and the wing boxes shall be returned to the contractor for analysis and inclusion of results in their final technical report.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0024, MILITARY FLYING QUALITIES RESEARCH
D.J. Moorhouse, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF132100)

This work unit supports TPO 3, flight control, and specific goal FG02A, flying qualities and development criteria. The mission effectiveness of all classes of military airplanes is heavily influenced by the flying qualities of the vehicle. The effects of flying qualities can range from minor nuisance to flight safety in nature. The objective of this effort is to plan and coordinate research programs to investigate new approaches to design criteria and to establish flying qualities requirements which will insure adequate airplane characteristics for the mission needs. The results of this effort will ultimately be incorporated into military specifications MIL-F-8785, 'Flying Qualities of Piloted Airplanes,' MIL-F-83300, 'Flying Qualities of Piloted V/STOL Aircraft,' and possible future specifications for remotely piloted vehicles.

This effort will consist of reviewing existing flying qualities requirements. Joint programs will be initiated with other government agencies employing fixed base and in-flight simulation capability. New concepts in control system analysis and handling qualities specifications will be examined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0025, REAL GAS DIAGNOSTICS AND SIMILITUDE
D.M. Parobek, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF142420)

Deficiencies exist in the present day technology concerning instrumentation systems and ground simulation facilities, especially for the adverse conditions encountered during re-entry. The objective is to overcome such difficulties by obtaining quantitatively and in real time the spatial and temperal thermochemical properties which characterize the flow fields in the

ground tests. Thus, the reduction of weapon system development costs can be realized by minimizing the number of expensive free flight tests.

More reliable and precise data base can be established by developing the electron beam fluorescence, emission and/or absorption spectroscopy, laser Raman scattering and their associated mechanical, electro-optical detection and data acquisition systems to cover different regimes of the flight profile of military weapon systems as required to fulfill DOD missions. Work units 14260106, 14260123, 14260125, 14260129, 14260130, 14260132, 14260139 and 19290414 are in process of termination and the remaining work of these will be consolidated under this new work unit.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0026, INVESTIGATION OF KEVLAR MATERIALS FOR DECELERATOR APPLICATIONS

W.R. Pinnell, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF136570)

Many military missions currently being performed incorporate a requirement for deployable aerodynamic decelerator systems to stabilize and/or recover special purpose payloads over a range including small electronic countermeasure devices and entire operational aircraft. The problem addressed by this effort is the reduction of the weight and volume required for decelerator systems. The objective of this effort is to integrate Kevlar 29, a high strength to weight fiber for textile materials, into decelerator system technology. Application of the Kevlar 29 textiles will permit volume and weight reductions of approximately 50 percent when compared to currently used nylon materials.

Experimental Kevlar parachutes will be tested in a controlled manner to determine proper design criteria for efficient Kevlar 29 utilization. Test items will be 15.3 ft conical ribbon parachutes. Horizontal ribbons and suspension lines are the parachute components of primary interest.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0027, BOUNDARY LAYER MEASUREMENT TECHNIQUES FOR SIMULATED SUBSONIC & HIGH SPEED FLIGHT OF MILITARY AIRCRAFT & WEAPON SYSTEMS

E. Robinson, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF120710)

The performance of advanced high speed military aircraft and weapon systems can be seriously affected by the aerodynamic characteristics and the flow field surrounding these vehicles. This influence can be ascertained by defining the flow field surrounding these vehicles through the simulation and measuremrnt of aerodynamic quantities in ground test facilities. The problem is to develop the techniques to quantitatively analyze boundary layer phenomena and problems occurring in the simulation facilities and to correlate the test results with the actual flight vehicle environment. The results of this work effort will provide devices and equipment to sense, record, and analyze test article and flight system flow data in mass effects and local properties from boundary layer profile surveys.

Development of circuitry and techniques for measuring vital facility and test model parameters. Develop diagnostic techniques for measuring the basic flow properties in these facilities stressing particularly those methods which do not interfere with the flow. Develop and adapt electronic equipment to meet unique facility and test needs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0028, PRELIMINARY DESIGN OF AIRCRAFT STRUCTURES

R.S. Sandhu, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF143760)

To reduce the acquisition and maintenance costs and to insure a high degree of structural integrity and reliability of future air force weapon systems, it is imperative to develop reliable light weight and low cost airframe structures. The objective of this program is to develop new, low cost structural concepts for Air Force weapons systems, and to enhance the capability of the preliminary design group in the areas of design-analysis techniques for the design and the evaluation of these concepts using advanced materials.

New structural concepts and arrangements using metallic, composites and hybrid materials will be designed, fabricated, and validated by tests resulting in an improved structural technology base.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0029, FORWARD SWEPT WING AEROELASTIC STUDIES

V.C. Sherrer, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF142370)

Recent analytical studies have shown that forward swept wings offer the performance advantages of reduced drag and increased maneuverability over aft swept wings. The construction of all-metal forward swept wings was first attempted in the late 1930's, but until recently, designs with large forward sweeps proved to be impractical. This was because prohibitive weight increases in the wing structure were necessary to overcome the static instability known as divergence. Current analyses have shown, however, through the use of aeroelastic tailoring of advanced composite wing skins, the divergence problem can be eliminated without a significant weight penalty. The objective of this work unit is to provide experimental verification of the ability of advanced composites to eliminate divergence in forward swept wings while also satisfying flutter requirements. A secondary objective is to provide the investigators with an increased understanding of the mechanism of divergence and its relationship with advanced composite materials. This study will contribute to the advancement of forward swept wing technology and to possible improved performance of future military aircraft.

Design and analysis studies are first conducted on various forward swept wing configurations. Then an aeroelastic low speed wind tunnel model configuration is selected and designed using the computer procedures TSO and NASTRAN. The cantilever wing model will be a simple composite plate with a balsa or foam sleeve forming a symmetrical airfoil. The model will be designed to diverge within the low speed wind tunnel operating regime. If possible, flutter characteristics of forward swept wings will also be experimentally determined. A cable restraint system will be used to prevent model destruction. Low speed wind tunnel tests will be conducted with several composite plate designs and other important parameter variations. Experimental results will be compared with analytical predictions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0030, FEASIBILITY DEMONSTRATION OF A RETARDATION AND AUTOMATIC FLOTATION (RAFT) SYSTEM FOR THE 'VERTREP' MISSION

W. Wiesmann, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN681034)

Demonstrate the feasibility of a helicopter installed system designed to provide deceleration during free fall and subsequent flotation of high value cargo that has been intentionally jettisoned or inadvertently dropped during vertical replenishment operations over water. Automatic deployment of the system is planned to prevent specified levels of damage to the cargo upon impact with the water to avert sinking and to facilitate recovery by surface ship or helicopter. The system will be readily adaptable to all helicopters which are normally used in the VERTREP mission. This work is supported by work units PH104B and PH104B1.

It is planned to study, analyze, design and test equipment to facilitate recovery of a nuclear weapon or other high value

cargo which is separated from a helicopter during vertical replenishment operations over water.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0031, DEVELOPMENT OF A FLIGHT TEST PROGRAM FOR A COMPOSITE AIRCRAFT

R.O. Stearman, University of Texas, Austin Campus, School of Engineering, Dept. of Aerospace Engineering & Engineering Mechanics, *200 W. 21st, Austin, Texas* 78712

DESCRIPTION: In 1977 the first FAA certified all-composite aircraft was donated to the Aerospace Engineering and Engineering Mechanics Department of The University of Texas at Austin. Several flight research programs are being considered for this aircraft. These include an investigation of a mechanism of noise transfer into a composite aircraft cabin environment, an investigation of the influence of winglets on wingwake structure performance, and a study of subcritical flight flutter testing techniques for general aviation aircraft. On-board digital data acquisition and recording systems are being developed for these programs. The study attempts to initiate a general aviation research program within the department. This continuing experiment is in its second year.

SUPPORTED BY University of Texas

1.0032, NUMERICAL METHODS FOR VISCOUS FLOWS

T.A. Zang, College of William & Mary, Williamsburg College, School of Arts & Sciences, Dept. of Mathematics & Computer Science, *Ewell Hall, Williamsburg, Virginia* 23185 *(NAG 1-109)*

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0033, STUDY OF VORTICULAR STRUCTURE IN TURBULENT BOUNDARY LAYERS

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SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0034, ANALYSIS OF AEROTHERMODYNAMIC ENVIRONMENT OF AN AEROCAPTURE VEHICLE

S.N. Tiwari, Old Dominion University, School of Engineering, Dept. of Mechanical Engineering & Mechanics, *5201 Hampton Blvd., Norfolk, Virginia* 23508 *(NAG 1-120)*

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

1.0035, HT 79-17, EVALUATION OF THE EFFECTS OF VOIDS IN COMPOSITE MAIN ROTOR BLADES

D.G. Orlino, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Applied Technology Lab., *Fort Eustis, Newport News, Virginia* 23604 (DA0G2046)

(a) To determine the propagation characteristics, under repeated loading, of typical manufacturing flaws and defects found on composite main rotor blades. The results obtained from the testing of the K-747 blade will be relevant to composite blades in general and instrumental in defining the need and direction for additional research in this area. (b) results of testing will, hopefully, serve as an indication as to whether or not void growth problems exist on the K-747 blade.

(a) A total of four K-747 blades shall be tested. Two blades are from the developmental program and two blades will be from the low-rate initial production (LRIP) program.each blade will be placed in the resonant test fixture and fatigue tested under the design loading spectrum for the AH-1Q helicopter. (b) each blade will be nondestructively inspected to establish a firm baseline of delamination present in the spar. The blades shall be periodically inspected to determine the growth rate of existing flaws, the creation of new flaws, and any insipient failure. If void growth is absent after 28-million cycles of spectral loading, the load will be increased and testing continued until void growth is present.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0036, HT 80-8, DOCUMENTATION OF A STRIP ANALYSIS METHOD FOR PROPELLERS AND ROTORS IN AXIAL FLOW.

W.A. Pleasants, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Applied Technology Lab., *Fort Eustis, Newport News, Virginia* 23604 (DA0G2723)

To provide a software package which combines all capabilities of the current prop routine in a single program and documents the theory, code, and application of the analysis method.

Existing programs shall be combined to generate a single program capable of treating fixed pitch and variable speed propeller performance, non-dimensional rotor performance in hover and climb, and complete configuration analysis in hover and climb. The documentation of theory, code, and correlation shall be updated.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0037, HT ST 79-12 ADVANCED STRUCTURAL ELEMENT DEVELOPMENT

D.M. Saylor, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Applied Technology Lab., *Fort Eustis, Newport News, Virginia* 23604 (DA0G2934)

To develop advanced structural design concepts which will provide improvements in structural efficiency, safety and survivability, and reliability and maintainability. This effort will assure that the army has the most up-to-date technology available to perform its mission in an efficient manner. Emphasis will be placed on developing new concepts to improve the structural performance and reduce the acquisition and life-cycle cost of aircraft structures.

Material specimens of solimide will be tested to determine material properties. Additional spaceweave cylinders will be fabricated to determine optimal spacing of fiber bonds to give best ballistic damage survivability. A data base management system will be developed to provide rapid access to material properties of materials and adhesives currently used in Army aviation research and development (R&D).

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0038, HT ST 75-30 - IMPACT BEHAVIOR COMPOSITES - ARMY HELICOPTERS

Unknown, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Applied Technology Lab., *Fort Eustis, Newport News, Virginia* 23604 (DA0E3832)

Determine the differences in nonlinear load deflection characteristics between a substructure fabricated with aluminum and the same substructure fabricated with composite materials. The feasibility of applying the analytical and testing techniques used in USAAMRDL TR 74-12 to similar structures fabricated with composites will be investigated.

Phase I - the analytical and testing techniques used in USAAMRDL TR 74-12 will be reviewed. The technical feasibility of performing scale model tests of the candidate designs will be investigated by analyzing and statically testing and impact testing a one-half scale model of the test specimen of USAAMRDL TR 74-12. Phase II - the phase I substructure will be redesigned using composite materials. Each of the composite substructure designs will undergo stress analysis, static testing, drop impact testing, and post-test analysis.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Applied Technology Lab.

1.0039, HT ST 76-26 - RPV COST AND WEIGHT REDUCTION INVESTIGATION

Unknown, U.S. Dept. of Defense, Army, Aviation Research & Development Command, Applied Technology Lab., *Fort Eustis, Newport News, Virginia* 23604 (DA0E3835)

The technical objective is to determine methods for reducing weight and cost of RPV structural components. Particular emphasis is to be placed on the capabilities of manufacturing structural shapes and attachment points in a cost effective manner.

Using the basic aquila airframe design, or realistic vehicle structural weight will be selected. Various manufacturing techniques will be evaluated to determine which technique offers the best compromise between lightest weight and longest life. The applicability of these methods will be determined by the fabrication of selected component part of the aquila. Weight and costcomparison will be made for the various structural concepts.

SUPPORTED BY U.S. Dept. of Defense, Aviation Research & Development Command, Research & Technology Lab.

1.0040, INFLUENCE OF SMALL SURFACE ROUGHNESS ON TURBULENT FLOW OVER SOLID AND POROUS SURFACES

J.A. Schetz, Virginia Polytechnic Inst. & State University, School of Engineering, Dept. of Aerospace Engineering, *Blacksburg, Virginia* 24061 (NAG 1-119)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, CARBORANE BURNING RATE MODIFIERS FOR SOLID PROPELLANTS

W.E. Hill, Auburn University, School of Arts & Sciences, Dept. of Chemistry, *Auburn, Alabama* 36830 (DN590853; N00024-75-C-5318)

To perform research on carborane compounds for use as propellant burning rate catalysts. Three main problems will be investigated; (1) possibility of migration from the propellant, (2) undesirably high-melting points, and (3) low yield synthesis.

To prevent migration, existing binders will be modified by using carboranyl plasticizers which react with double bonds of the polymers on curing. Hydroxy terminated polybutadiene (HTPB) and carboxy terminated polybutadiene (CTPB) polymers will be reacted with functional carboranes to make polymers containing boron which should not migrate easily. Silyl carboranes containing si-si bonds or si-c bonds will be synthesized. These compounds should yield high burning rates with less carborane which should be less volatile. Difunctional carboranyl isocyanates and epoxides for use as curing agents will be synthesized. What effect a Lewis base has on the reaction rate, activation energy and yield of ortho carborane will be determined. Carboranes will be synthesized from acetylenes for improved yield.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

3.0002, MATERIALS SUPPORT TECHNOLOGY: LIQUID DROP IMPACT DAMAGE FOR CERAMIC MATERIALS

W.F. Adler, Effects Technology Inc., *Santa Barbara, California* 93105 (DN675494; N00014-76-C-0744)

The erosion of infrared sensor windows, infrared laser windows, and radomes exposed to rain, ice crystals and airborne dust and debris is a serious problem for all-weather subsonic and supersonic aircraft and missile systems. Investigation of mechanisms of damage in crystalline inorganic materials at impact velocities ranging from 100 to over 1,000 feet per second will be addressed. This will provide rational directions for development of erosion resistant materials via modification of microstructural features.

Work concentrates on damage by water drop impacts on surface defects, influences of bulk material modifications on damage initiation and propagation, and materials removal mechanisms. Materials include single crystal CaF2, MgO, and Si, and polycrystalline CVd ZnS and MgO. They will be impacted with hard solid particles (first three), nylon beads (all), and water (all). Included are static and dynamic indentation resistance, fracture thresholds, surface finish, microstructure. Interactions of water drops with model defects are to be examined. Fracture mechanics analyses and descriptions of erosion kinetics will be developed.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0003, SURVEILLANCE - MERCURY HALIDE LASER KINETICS

R. Zare, Stanford University, School of Humanities & Sciences, Dept. of Chemistry, *Stanford, California* 94305 (DN875194; N00014-78-C-0132)

The objective of this work unit is to gain a thorough understanding of the basic atomic and molecular processes involved in the operation of the direct electric discharge excited mercury halide laser. This laser is a leading candidate for underwater surveillance and general ocean-optics applications for naval use.

To accomplish the proposed objective the rate of deactivation of the upper laser level that results from collisions with atomic and molecular species will be measured and vibrational relaxation processes will be investigated for both electronic levels that are involved in laser operation. Absolute cross-sections and vibrational energy distributions will be determined for metastable-dihalide collisional excitation processes involving both rare gases and Hg.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0004, COMPOSITE MATERIAL E3

S. Jauregui, U.S. Dept. of Defense, Navy, Naval Postgraduate School, *Monterey, California* 93940 (DN998066)

To support the navair program of electromagnetic systems design of advanced composite material aircraft.

Participate in AV8B composite wing EM tests and reduce data from tests. Analyze results of Porter P-static flight tests and identify areas of importance for continuation of experiments. Improve the performance and calibration of broadband omnidirectional EM field probes. Identify, demonstrate and recommend EM testing technology for composite aircraft sections which will produce needed improvements below 2 MHz.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

3.0005, ELECTRONICALLY EXCITED MOLECULES

E.K. Lee, University of California, Irvine Campus, School of Physical Sciences, Dept. of Chemistry, *Irvine, California* 92664 (CHE79-25451)

With support by a grant from the Chemical Dynamics Program Professor Lee will investigate the chemical dynamics of molecular processes involving electronically excited states of small molecules. Dynamics of intra-molecular energy flow and ensuing chemical reactions in energy rich molecules ('isolated' molecules as well as 'van der Waals' molecules) will be of particular interest. The goal of this research is to provide experimental information on the energy distribution and its chemical effects and some theoretical interpretations of the observed phenomena. The methodology will be to elucidate: (a) primary 'unimolecular' processes in photoexcited molecules; (b) primary 'pseudo-unimolecular' processes in photoexcited cage dimers trapped and isolated in low temperature matrices and van der Waals molecules in supersonic nozzle beams; (c) the relationship between the collision complex involved in 'bimolecular' energy transfer processes and the van der Waals and cage dimers involved in 'pseudo unimolecular' processes; (d) the dependence (on the initial states of the reactants) of the nature of the reaction products and the energy distribution and (e) oxidation mechanisms involving excited states, particularly in oxygen atmosphere and reactive matrices.

This is a renewal of support for research currently supported by NSF grant, CHE 7680383.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0006, INVESTIGATION OF GAS-PHASE REACTIONS OF IMPORTANCE IN IGNITION PROCESSES 14175-CX

S.W. Benson, University of Southern California, School of Letters Arts & Sciences, Dept. of Chemistry, *3551 University Ave., Los Angeles, California* 90007 (DA0E9112; DAAG29 76 G0195)

(1) To measure rates and determine mechanisms for a number of gas-phase reactions of importance in hydrocarbon-oxygen ignition processes, (2) to evaluate known flame and ignition inhibitors for their probable chemical roles in influencing important ignition steps, and (3) to evaluate the role of the above reactions in ignition and inhibition processes in light of the rates obtained. Relevance - the Army uses large quantities of flammable liquids in its ground combat vehicles and aircraft. Fuels in particular, increase the vulnerability of vehicles to munitions attack and make storage areas quite hazardous during combat. To understand and thereby control fire and explosion hazards of fuel storage areas and to develop the needed 'fire-safe fuels', knowledge of the basic chemistry of ignition and inhibition is essential.

Rates will be determined using three distinct experimental approaches. (a) Very low-pressure pyrolysis (VLPP) methods will be used to study a number of key reactions involving alkyl radicals, alkylperoxy radicals, and oxygen. (b) Higher pressure static or flow methods will be used to investigate reactions of alkyl hydroperoxides with peroxy radicals, with or without added inhibitors. (c) A method using a laser pulse to rapidly hear and thereby induce reaction in an appropriate gas mixture will be used to study hydrocarbon radical-oxygen-inhibitor reactions free of unwanted wall and induction period effects.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

3.0007, COLLISION PROCESSES D

F.C. Fehsenfeld, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (BDJ43032)

PROJECT OBJECTIVE: To pursue our laboratory studies of ion-neutral reactions and ion mobilities needed to understand ionospheric stratospheric ion chemistry. These measurements, coupled with the calculational program in spectroscopy, will be used to understand the optical properties (UV, visible and infrared emission and absorption) of the atmosphere.

CURRENT YEAR PLAN: Using the temperature variable flowing afterglow system, the flow-drift technique, and mass selected ion injection techniques, kinetic energy and temperature dependencies and ion-neutral reaction rate constants will be measured, including studies using unstable neutral reactants, including atomic oxygen, atomic nitrogen and vibrationally excited nitrogen as reactants. In addition to their application to modeling atmospherically ion chemistry, these studies will provide basic thermochemical data concerning atmospheric ions and neutrals.

PROGRESS REPORT: 1. Ion-molecule reaction rate constants of atmospheric importance were measured. 2. A program has been initiated to measure the mobilities of atmospheric ions in the air. 3. Our calculational program in spectroscopy was utilized to construct potential energy surfaces for atmospherically important atmospheric ions. 4. A mass selected ion injection system has been put into operation in our laboratory. Rate constants for important F-region ion molecule reactions have been made utilizing this new technique.

SUPPORTED BY U.S. Dept. of Defense, Defense Nuclear Agency

3.0008, ANALYSIS OF AIRCRAFT ENGINE OIL SAMPLES BY NEUTRON ACTIVATION TECHNIQUES

T.A. Menard, U.S. Dept. of Defense, Air Force, Air Force Academy, Physics Dept., *Colorado Springs, Colorado* 80840 (DF282210)

A continuation of the feasibility study conducted during 1976. This study will attempt to determine the feasibility of using a CF252 neutron source for activating aircraft oil samples as a means of supplementing the USAF spectroscopic oil analysis program. This project will determine if the neutron activation method is faster and/or more accurate than presently used methods of determining trace contaminates in oil.

(a) A CF252 source will be obtained on loan from ERDA. (b) Calibration standards will be prepared and curves established for the 13 elements of interest in oil analysis. The approach will be to determine the optimum method for observing each element in order to obtain the lower limit in PPM plus or minus 10 percent. (c) Aircraft engine oil samples will be activated and the trace metal concentrations determined using the calibration curves. By comparing these results with those obtained by the soap methods a conclusion can be drawn concerning the value of this method in relation to the established methods.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Frank J. Seiler Research Lab.

3.0009, ION IMPLANTED GaAs MATERIALS

J.E. Davey, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN880396)

The objective of this research task is to establish an interactive program with the Wright Patterson Materials Laboratory on the ion implantation technology for GaAs with the intent of establishing a sound basis for determining the controlling parameters of said process as applied to both Air Force and Navy device and circuit programs.

The approach will be as follows: to use a common material source of GaAs; to implant according to variety of conditions in each laboratory; to encapsulate selected samples in each laboratory and anneal; to transfer selected ion implanted samples to the other lavoratory for encapsulation and anneal; to separately evaluate the samples and then exchange; to do these experiments as a function of HKL; to establish a transferable process; to do detailed cross correlation on electrical and optical evaluation.

SUPPORTED BY U.S. Dept. of Defense, Navy

3.0010, PROCESSING OF HIGH Tc SUPERCONDUCTORS

D.U. Gubser, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN680280)

This program is to develop fabrication techniques for the production of high Tc superconducting materials and to demonstrate their useful properties for systems applications. The present effect is to develop to the point of production readiness multifilamentary V3Ga composite wire and to explore techniques for fabricating improved Nb3Ge conductors. The program is to develop processes and fabrication procedures which are amenable to commercial production.

The present effort is to use the technology developed at NRL for making multifilament V3Ga wire and to commercially produce long lengths of high filament density wire. Measurements of the critical current of V3Ga as functions of temperature, magnetic field, and other important engineering parameters will be compared with alternative superconductors. Similarly, technology for fabricating improved Nb3Ge conductors is being developed.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Sea Systems Command

3.0011, MATERIAL SUPPORT TECHNOLOGY

H.B. Rosenstock, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN620095)

The objective of this work is to carry out the underlying theory and experiments concerning materials of interest to the

Navy. Emphasis is currently placed on determining the physical origin of the attenuation in weakly absorbing materials which may be employed in high power laser windows, thin films, atmospheric gases, and fiber optics, but other applications are also studied as they arise.

The mid and long-term Navy material needs are periodically assessed and research is undertaken to fulfill those needs deemed most critical and for which investigation seems most likely to result in solution of these needs. In the past, this has concentrated on laser windows. At present, the ultimate limitation on laser propagation through atmosphere is also studied.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

3.0012, COOLED HOLLOW CERAMIC AIRFOIL EVALUATION PROGRAM

Unknown, United Technologies Corp., Pratt & Whitney Aircraft Group, *P.O. Box 2691, West Palm Beach, Florida* 33402 (DF463710; F33615-79-C-2024)

The objective of this program is demonstrate the feasibility of using ceramic materials for cooled airfoil applications.

This will be a single phase, four task study to design and evaluate ceramics for cooled airfoil applications.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

3.0013, EVALUATION OF A NOVEL HYDROCRACKING CATALYST FOR CONVERSION OF SHALE OIL INTO HIGH YIELDS OF JET FUEL

Unknown, Standard Oil Co. of Indiana, Amoco Oil Company, *Box 400, Naperville, Illinois* 60540 (DF464550; F33615-79-C-2095)

To determine how effectively a novel, AMOCO developed catalyst system converts whole crude shale oil into high quality feedstocks with high yields in the jet fuel boiling range.

Bench scale equipment will be used to evaluate the effectiveness of the new AMOCO-developed catalyst system for hydrocracking whole crude shale oil at varying combinations of temperature pressure and flow rate. Catalyst composition and catalyst support chemical and physical properties will be varied to determine the best configuration for shale oil processing.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

3.0014, TUNGSTEN ALLOY DEVELOPMENT

W.F. Chiao, U.S. Dept. of Defense, Army, Army Materiel Development & Readiness Command, Materials & Mechanics Research Center, *Watertown, Massachusetts* 02172 (DA0G4766)

This project is designed on the principle that the armor defecting potential of tungsten kinetic energy core alloys is dependent on the synergy of high density and integrated mechanical properties. The main thrust is to focus chemistry and process investigation on 97 percent tungsten-matrix composites of various compositions to achieve the desirable mechanical properties for penetrator materials. The overall objective is to relate metallurgical and mechanical properties to the final ballistic results obtained.

The 97 percent w-matrix composites will be designed in terms of the matrix-alloy systems using Ni as the primary binding element and Fe, Mn, Cr, Co, and Cu as the major alloying elements and Mo, Ti, Ta, Al, etc. as the minor alloying elements. The major emphasis is to apply P/M techniques to produce high density and uniform microstructure and sufficient integrity in mechanical properties through liquified sintering, heat treatments and mechanical working processes.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Materials & Mechanics Research Center

3.0015, HOT ISOSTATIC PRESSING OF TITANIUM POWDERS

S. Isserow, U.S. Dept. of Defense, Army, Army Materiel Development & Readiness Command, Materials & Mechanics Research Center, *Watertown, Massachusetts* 02172 (DA0G4760)

Consolidation of aircraft quality powder metal shapes and preforms by hot isostatic pressing (HIP) presently requires use of costly gas-tight containers which are expended in process. Partly because of container expense, HIP parts are commonly limited to simple shapes, e.g. discs and cylinders. The objective of this research is development of a HIP method for consolidation of metal powders to obtain irregular shapes, employing reusable molds and obviating the need for expendable containers. Consolidation of titanium alloy compacts will be undertaken with intent of demonstrating materials suitable for application in drive systems of helicopters replacing forged or cast parts.

The approach will investigate partial consolidation of loosely compacted powder metal preforms by formation (or infiltration with) a transient-liquid-phase which, interacting with the basic powder, forms a higher melting product and solidifies, leaving at least an impervious skin. The partially consolidated item will then be removed from its mold and transferred to a HIP unit for further compaction and homogenization, without further encapsulation. Properties of titanium alloy compacts consolidated by this process will be determined and reported.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Materials & Mechanics Research Center

3.0016, EVALUATION OF MATERIALS FOR FREE DROP CONTAINER

R. Vernet, U.S. Dept. of Defense, Army, Natick Research & Development Command, *Natick, Massachusetts* 01760 (DA0H4281)

Provide an end item to replace the standard container (NSN 1670-00832-5917) which is no longer available for procurement and which was developed in accordance with the DA small development requirement (SDR) for free drop container for liquids. The SDR required the free drop of food and water to personnel operating in remote areas from aircraft flying at maximum 130 KIAS, maximum 76M above the ground.

Evaluate plastic film materials as possible replacement for the modified polyurethane material presently prohibited from use in the standard item. The item/items selected will then be airdrop tested for conformance to requirements.

SUPPORTED BY U.S. Dept. of Defense, Army, Natick Research & Development Command

3.0017, THEORY OF HIGH-ENERGY ION-ATOM AND ATOM-ATOM COLLISIONS

J.S. Dahler, University of Minnesota, St. Paul Campus, Graduate School, Dept. of Chemistry, *St. Paul, Minnesota* 55101 (CHE79-14174)

This grant supports research under the Quantum Chemistry Program for the development and testing of theoretical procedures to estimate cross sections of the excitation and quenching processes that take place in high-energy ion-atom and atom-atom collisions. Among the many systems to be considered are collisions in the range of 1 to 200 keV between rare gas target atoms and projectiles such as Be ion, Mg ion, Li and Na. The processes of interest include excitation and quenching of the projectile atoms, excitation of the target rare gas, charge exchange, and electron detachment.

Professor Dahler's theoretical program is coordinated closely with experimental studies which provide information about the moduli and relative phases of the scattering amplitudes associated with different substates of an excited atomic term. An objective of Dahler's project is to develop a theoretical analysis of these events in order to understand the underlying scattering mechanisms and to predict reliable numerical values of the observables.

This is a renewal of research currently supported by NSF grant CHE7611037 at the University of Minnesota.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0018, STRUCTURES OF DISPERSED LYOTROPIC LIQUID CRYSTALLINE PHASES

S. Friberg, University of Missouri, Rolla Campus, School of Arts & Sciences, Dept. of Chemistry, *103 Parker Hall, Rolla, Missouri* 65401 (DMR80-010690)

Lyotropic liquid crystals are important as model substances for biological membranes, and are an important part of emulsion systems in food, pharmaceuticals, polymer technology, and tertiary oil recovery technology. Basic research in this area is in fast development. Until recently, this research has been entirely focused on systems with water as the solvent. The Rolla group has recently shown that lyotropic liquid crystals may be obtained also with non-aqueous solvents. The goal of the present work is to explore this new class of compounds.

The research program consists of the following sections: (a) determination of those aspects of the chemical structure of the solvent that give rise to liquid crystalline structures; (b) the molecular dynamics of the solvent molecules and their interaction with the amphiphilic host molecule, and (c) the dislocation patterns of the non-aqueous lyotropic liquid crystals and their dispersions, studied using an improved cryogenic freeze technique.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0019, GAS-SURFACE INTERACTIONS IN CRYOGENIC WHOLE AIR SAMPLING

J.M. Calo, Princeton University, School of Engineering & Applied Sciences, Dept. of Chemical Engineering, *Box 430, Princeton, New Jersey* 08540 (DF248590; F19628-77-C-0071)

AF function - stratospheric trace gas measurements are conducted to establish if Air Force flight operations are altering the composition of the stratosphere in any way which might produce a harmful environmental change. Deficiency or opportunity - there exist physico-chemical problems related to the collection, storage, manipulation, transfer and analysis of these gases by cryogenic techniques. Objective - under the contractual effort, theoretical and laboratory experimental investigations are intended to determine sticking and flaking of the gas species on cryogenic surfaces composed of various materials and to study potential chemical conversions on such surfaces.

A vacuum chamber/gas sampling system employing mass spectrometry for diagnostics will be designed and constructed. Gas samples, chosen for their applicability to stratospheric composition studies, will be introduced to the system and chemical conversions and sticking and flaking on cryogenic surfaces of different materials will be investigated. Also, the effects of sampling rates and modes as well as sample warmup will be studied. No to no sub x conversion and determination of sticking coefficients for Freons 11 and 12 on cryogenics surfaces will receive special attention.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

3.0020, DEFECTS AND DEFECT MOBILITY IN IONIC CRYSTALS

A.S. Nowick, Columbia University, Henry Krumb School of Mines, Dept. of Metallurgy & Materials Science, *Broadway & W. 116th St., New York, New York* 10027 (DMR80-06326)

This research is concerned with point defects in anisotropic (i.e. non-cubic) ionic crystals. Such crystals are of great technological interest and their anisotropy offers additional tools for their study. Basic knowledge of their defect structures, however, lags well behind that of cubic ionic crystals. Three crystals are involved in the present study. The first, tetragonal MgF2, is doped with trivalent cations (e.g. Cr(III), FE(III)). In this way it is hoped to learn more about the intrinsic defect structures of this material. The second investigation deals with slightly reduced rutile (TiO2); anelastic techniques are used to try to determine the type of point defect present, and the conditions under which extended defects, rather than point defects, are formed. This will be of value for understanding more complex materials which form extended defects. The final study is a continuation of the author's investigation of the electrical properties of alpha quartz crystals. To simplify the complexities arising from crystals from different sources, a single species of alkali ion is introduced as the sole monovalent impurity and studied both before and after irradiation. The effect of irradiation is of special interest for maintaining the frequency stability of quartz used in guidance systems. It is also of basic interest since radiation liberates monovalent defects from their bound sites.

First year of a three-year continuing grant; renewal of work supported by DMR77-07141.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0021, HIGH TEMPERATURE COMPOSITE MATERIALS FOR AIRCRAFT ENGINE COMPONENTS

I. Ahmad, U.S. Dept. of Defense, Army, Armament Research & Development Command, Benet Weapons Lab., *Watervliet Arsenal, Watervliet, New York* 12189 (DA0A1708)

To develop fabrication technology and study high temperature mechanical behavior of high strength high temperature filament reinforced superalloy composites suitable for the fabrication of high temperature components (such as turbine vanes, blades, combustion and exhaust systems, etc.) for advanced Army aircraft engines.

Prior years work demonstrated the successful reinforcement of fecraly with silicon carbide fil coated with tungsten. In FY78 composite specimens containing HFC coated silicon carbide filament were fabricated by diffusion bonding process. Additional specimens will be made to study their tensile and stress-rupture properties in 1000-2000 degrees F range. Kinetics of HFC-fecraly interaction at various temperatures will be investigated. Also interaction kinetics of the matrix with coatings other than HFC. Such HFN will be studied.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Benet Weapons Lab.

3.0022, APPLICATION OF PHOTOACOUSTIC TECHNIQUES TO THE STUDY OF JET FUEL RESIDUE

P.C. Claspy, Case Western Reserve University, School of Science, Dept. of Chemistry, *2165 Adelbert Rd., Cleveland, Ohio* 44106 (NAG 3-98)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

3.0023, NAVY ENVIRONMENT - ENVIRONMENT ENHANCED SUBCRITICAL CRACK GROWTH IN STEEL AND TITANIUM ALLOYS

R.P. Wei, Lehigh University, Inst. for Fracture & Solid Mechanics, *Alumni Memorial Bldg., Bethlehem, Pennsylvania* 18015 (DN223484; N00014-75-C-0543)

The objective of this research is to determine the mechanisms of environment enhanced subcritical crack growth (stress corrosion/corrosion fatigue) in steels and titanium alloys used in naval structures.

The rate of crack growth in steels and titanium alloys will be determined as a function of partial pressure of water vapor in the atmosphere, test frequency, wave form and temperature. Concurrent investigations of the chemisorption kinetics, reaction mechanisms and activation energies of adsorption of water on these same materials will be carried out as a function of temperature and water-vapor pressure. On the basis of the chemical and mechanical studies, kinetic models of the crack growth processes will be formulated.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0024, RESEARCH ON MULTIPURPOSE CORROSION INHIBITORS FOR AEROSPACE MATERIALS IN NAVAL ENVIRONMENT

V.S. Agarwala, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN081282)

To minimize corrosion failures such as corrosion fatigue stress crrosion cracking, wear and general corrosion in naval aircraft through one process or product. To develop and formu-

late new multipurpose versatile inhibitors or inhibitor system which can protect high strength structural alloys steels and Al alloys from various forms of corrosion. To produce applicable methods and/or products for fleet which can be incorporated into paint primers, lubricants and surface treatment procedures.

Known mechanisms of corrosion reactions specific to naval aircraft corrosion failure problems are considered to generate few basic steps fundamental to overall corrosion controlling concepts. Each step will be studied individually and attempts will be made to develop or search chemical compounds, mostly inorganic, as single function inhibitors to control them. The current state of the art electrochemical and metallurgical methods will be used to characterize their corrosion mitigating chemical properties. The unique aspect of this program is that the corrosion inhibiting properties of all these different chemical compounds' functional inhibitors will be combined together into a formula to produce a multi-functional inhibitor of a versatile nature. The technique of phase transfer catalysis will be used to dissolve inorganic compounds into organic solvents.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

3.0025, THEORY OF NONLINEAR OPTICAL SUSCEPTIBILITIES

H.F. Hameka, University of Pennsylvania, School of Arts & Sciences, Dept. of Chemistry, *34th & Spruce Sts., Philadelphia, Pennsylvania* 19104 (CHE77-22638)

In present and future lightwave communication systems there is an urgent need for a number of devices such as modulators, amplifiers, couplers, etc., which are capable of processing high intensity light beams. The operation of such devices depends on certain nonlinear optical and electro-optical effects. Professor Hameka will calculate various linear and nonlinear electric susceptibilities that represent the magnitudes of these nonlinear optical effects. In particular he will develop theories that relate the magnitudes of these susceptibility terms to chemical structure. Such calculations should lead to the identification of materials that have unusally large nonlinear electric susceptibilities. Particular attention will be paid to conjugated and aromatic molecules and to unsaturated polymers.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Chemistry

3.0026, POLY (ARYL ETHERS) - EFFECT OF POLYMER STRUCTURE ON RADIATION RESISTANCE

J.E. McGrath, Virginia Polytechnic Inst. & State University, School of Arts & Sciences, Dept. of Chemistry, *Blacksburg, Virginia 24061 (NAG 1-106)*

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

3.0027, ENERGETICS OF POLYMER CRYSTALLIZATION

B.L. Farmer, Washington State University, School of Engineering, Dept. of Materials Science & Engineering, *Pullman, Washington* 99163 (DMR77-20604 A01)

This research deals with computerized model building of the crystallization of polymers. It involves theoretical analysis and evaluation of hypothetical molecular events that can be evisioned to take place during the crystallization process. This type of analysis supplements the more usual phenomenological approach and should, if successful, resolve some of the heretofore unexplained experimental observations. The principal emphasis will be on the formation of polyethylene crystals and include studies of: a) the low-energy conformations and modes of packing regular chain folds into single-crystal-like surfaces; b) possible modes of folding in the monoclinic structure of polyethylene; c) the energetics of molecular segments on the fold surface; d) the growth behavior near the intersections of growth faces; and e) the energetics of the crystallization process for defect-bearing molecules.

Time permitting, some experiments will be carried out on the cocrystallization behavior of polyethylene with lightly chlorinated polyethylene.

This is a renewal of NSF Grant DMR77-20604.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

3.0028, METALLURGICAL CHANGES IN THE HIGH TEMPERATURE FRETTING OF Ni AND Ti ALLOYS

R.B. Waterhouse, University of Nottingham, Dept. of Metallurgy, *University Park, Nottingham, England, United Kingdom (DA0C9407; DAJA37-75-C-2216)*

To conduct an experimental investigation of fretting on Ti and Ni base alloys in order to assess the role of metallurgical structure on the resistance or susceptibility of the alloys to such damage. Fretting occurs on metallic structures bolted, riveted or rigidly held together but subject to minute rubbing action as a result of flexure, vibration, loose tolerances, fit, etc. The highly localized damage induced may be points of initiation for fatigue cracks and is of particular concern in highly stressed components.

Two types of rig will be used to induce fretting on selected alloys under various loading conditions. Specimens will be sectioned for metallurgical examination in optical microscopes and SEM. Thinning from the reverse side will be attempted by ion-beam etching for TEM observations, possibly the HVEM. Other techniques will be used as required, i.e. X-ray diffraction, probe, ESCA.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Research & Standardization Group

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, HOLOGRAPHIC LENSES FOR MISSILE GUIDANCE

B.D. Guenther, U.S. Dept. of Defense, Army, Missile Research & Development Command, Technology Lab., *Redstone Arsenal, Huntsville, Alabama* 35809 (DA0F1397)

To evaluate holographic lens technology for missile guidance application.

Construct a step zoom lens demonstration operating at 632.8 mm followed by the design and construction of a zoom lens that would demonstrate the ability to perform a beam rider type mission. Evaluate the performance of a corrector plate that would allow a missile to use a high performance aerodynamic profile without hampering the electro-optical subsystem.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Technology Lab.

4.0002, LASER PHOTOCHEMICAL REACTIONS

J.A. Merritt, U.S. Dept. of Defense, Army, Missile Research & Development Command, Technology Lab., *Redstone Arsenal, Huntsville, Alabama* 35809 (DA0G1064)

The objective of this task is to demonstrate the laser photochemistry synthesis of high performance propellants, burning rate stabilizers, and binder molecules for army missile applications and other costly, difficult-to-obtain Army materials.

Using laser photochemical reaction (LPR) techniques, irradiation of reactant gases with CO2, DF and/or other laser frequencies in a cost-effective synthesis of Army materials will be investigated. For the current fiscal year, studies of new synthesis of BF3 and the grafting or radical species to various compounds will be conducted.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Technology Lab.

4.0003, LOW TEMPERATURE MEASUREMENT OF THERMAL EXPANSION COEFFICIENT OF MIRROR SAMPLES FOR SHUTTLE INFRARED TELESCOPE FACILITY (SIRTF)

S.F. Jacobs, University of Arizona, Graduate School, Optical Sciences Center, *Tucson, Arizona* 85721 (NAG 2-64)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

4.0004, LIGHT PROPAGATION THROUGH CLOUDS (COMMUNICATIONS)

D.P. Woodman, GTE Sylvania Inc., Electronic Systems Group & Western Division, *Mountain View, California* (DN975090; N00014-78-C-0716)

(a) Experimentally demonstrate that it is possible to communicate through clouds with substantial optical thicknesses. (b) Obtain data which can be used to evaluate models for the propagation of light pulses through clouds.

Laser pulses will be transmitted from a high flying aircraft, through a cloud, to a ground based receiver. Observed pulse attenuation and distortion will be compared against the predictions of propagation models.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0005, ELECTRONIC PROCESSES IN InP AND RELATED COMPOUNDS

C.L. Anderson, Hughes Aircraft Co., Hughes Research Laboratory, *3011 S. Malibu Canyon Rd., Malibu, California* 90265 (DN890136; N00019-79-C-0533)

Determination of the characteristics of bulk InP that relate to its utility as an avalanche photo diode. A primary goal of this work shall be to measure the electron and hole ionization coefficients of commercially available bulk InP and to estimate carrier lifetimes.

InP will be characterized for physical perfection and determination of carrier concentration and mobilities. Schottky barrier and P-N junction structures will be used as analytical tools to determine ionization coefficients.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0006, ACOUSTIC WAVE TRANSDUCERS

G.S. Kino, Stanford University, School of Engineering, Dept. of Engineering, *Stanford, California* 94305 (ENG77-28528)

A research program concerned with new kinds of efficient transducers to excite Lamb waves and Rayleigh waves in nonpiezoelectric materials will be carried out. Such transducers are of interest in the field of nondestructive testing and for use with communication devices on nonpiezoelectric substrates such as silicon or isopaustic glass.

The basic principle to be followed is to work with wedge transducers and the derivatives of this technique of excitation. A complete theory will be developed based on a coupled mode formalism previously used in a simple form on this problem. The aim is to arrive at new classes of transducers for use at frequencies in the range from 1MHz to 200 MHz.

This is a continuation of research previously supported under NSF grant ENG-7518681.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0007, INVESTIGATION AND DEVELOPMENT OF AEROSPACE RECOVERY SYSTEM MATERIALS

R. Tubis, U.S. Dept. of Defense, Navy, National Parachute Test Range, *El Centro, California* 92243 (DN895412)

To obtain necessary information and develop safe and economical techniques for establishing: (a) service life of materials, components, and systems; (b) maintenance procedures for systems and components; (c) storage and packing techniques and environments for materials and components. Goals are to increase service and storage life, minimize maintenance, reduce bulk of packed parachute, and maintain or increase present reliability and performance standards.

Conduct test and evaluation to form a basis in theory, equations, and empirical data relating to material creep; cyclic fatigue; environmental effects of pressure packing, inert atmosphere storage, and packing methods, and destructive and nondestructive testing. These data will be used to establish service life, maintenance procedures, and storage/packing procedures, age life, and service life.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

4.0008, TUNNELING INVESTIGATIONS FOR OPTICAL ELECTRONICS

T.K. Gustafson, University of California, Berkeley Campus, Electronics Research Lab., *Berkeley, California* 94720 (ECS79-23877)

The principal aim of this research program is the study of the interaction of electronics within a metal-barrier-metal structure with an external radiation field to create various optical electronic components. Amplifiers based upon the stimulated emission of surface waves or the transistor principles of lower frequencies, lumped modulators, picosecond detectors, and lumped frequency converters are being pursued. The interactions can be coherent or incoherent although interactions which are incoherent for large junctions may be coherent when the dimensions of the device are reduced. The simultaneous study of coherent and incoherent interactions is interesting, since the fabrication problems are similar.

This is the first year of a three year continuing grant and this action renews the research that was previously supported under NSF Grant ECS76-84532.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Electrical Computer & Systems Engineering

4.0009, CHARACTERIZATION OF SEMI-INSULATING GaAs MATERIALS AND FET DEVICES

L. Forbes, University of California, Davis Campus, School of Engineering, Dept. of Electrical Engineering, *Davis, California* 95616 (ECS79-09955)

This program is concerned with the characterization of impurity and defect electronic states in gallium arsenide single crystals and with the influence of device processing procedures on the properties of the states. The investigation is focused on chrome and indium doped gallium arsenide samples used as semi-insulating substrates. Charge capture and emission behavior of the states is observed for materials subjected to device processing steps. Measurements are made both before and after device fabrication. Characterization techniques include transient capacitance and photocapacitance methods. Measurements on field effect devices obtained from industrial laboratories and subjected to differing integrated circuit processing procedures are part of the investigation.

This research was previously supported under NSF Grant ENG 76-80128.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Electrical Computer & Systems Engineering

4.0010, RESEARCH IN SOURCE-CHANNEL CODING AND COMMUNICATION NETWORKS

J.K. Omura, University of California, Los Angeles Campus, School of Engineering & Applied Science, Dept. of Systems Science, *405 Hilgard Ave., Los Angeles, California* 90024 (ENG77-20799)

Multi-user communication channels, communication networks, source-coding for multi-access channels and channel coding for channels with memory will be studied. Procedures for the efficient utilization of multi-access communication channels and networks will be examined under a variety of practically significant performance measures.

The problems to be investigated are divided into two classes. The first class of problems involves the extension of Shannon's classical channel coding theory for memoryless channels to channels with finite memory. Realistic channels are selected from models of nonlinear bandlimited satellite channels. Source-coding problems for communication networks will be investigated. The other class of problems involves the study of dynamic multiple-access disciplines for multi-access communication channels and networks. Application to computer communication networks, satellite networks, terrestrial radio and line data and voice networks will be considered. Synchronization procedures and adaptive data-compression schemes for communication networks will also be investigated.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0011, WEAPONRY - TURBULENT STRUCTURE DETERMINATION BY RAMANOGRAPH

R.K. Chang, Yale University, School of Engineering, Dept. of Engineering & Applied Science, *206 Elm, New Haven, Connecticut* 06520 (DN975315; N00014-79-C-0254)

The objective of this work is to (1) investigate by Ramanography the species concentration profile of reactive and nonreactive gases emerging from well characterized nozzles under turbulent and nonturbulent conditions, (2) develop pulsed Ramanography for instantaneous studies on large scale structures and entrainment in the turbulent mixing layer, and (3) measure the instantaneous temperature of combustion flames under equilibrium and nonequilibrium conditions. This experimental data on well characterized nozzles and new measurement techniques is needed for the study of combustors, turbine and nozzle entry flows, and engine exhaust flows - all to provide understanding to enhance future design of jet engines.

Raman and MIE scattering will be detected by a low light level TV camera to obtain instantaneous and simultaneous recording of concentration profile.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0012, ELECTRICAL DEVISES & CIRCUITS FOR USE IN RADIATION ENVIRONMENTS

H.L. Hughes, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN620084)

The Navy has a continuing need for high-density, high-performance semiconductor integrated circuits which can function reliably in satellite, missile, avionic, and ship systems exposed to severe nuclear radiation environments. The objective of the program is to determine fabrication processes by which to build near-ideal insulator/GaAs interfaces for MIS transistor gate and passivation regions.

Gallium arsenide, indium phosphide, as well as silicon-based devices, will be pursued for advanced, high-speed technologies. In-house experimental process research will be performed to fabricate ultra high-speed logic devices, especially MIS type. Insulator/semiconductor interface characterization will be performed.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0013, NEUTRINO APPLICATIONS

A.W. Saenz, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN880051)

The objective is to determine the feasibility of neutrino communication over global distances, point-to-point, directly through the earth.

The work requires the use of state-of-the-art theoretical methods of high energy and nuclear physics, acoustics, and communication engineering.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0014, LASER VULNERABILITY ADVANCED DESIGN SOLAR CELLS

R.L. Statler, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN980213)

The objective is to evaluate the vulnerability of advanced design solar cells to CW and pulsed high energy laser energy with the intent of defining specific damage modes and mechanisms. The results will provide guidelines for the design and manufacture of laser hardened solar cells for satellite applications.

Silicon and gallium-arsenide solar cells now being developed by the AF for space missions will be subjected to CW and pulsed CO2 high energy laser radiation at 10.6 microns. Cell characteristics including forward and reverse V-I curves, spectral response, and V-I curves at AMO will be measured before and after laser radiations. The changes observed in fundamental solar cell parameters will lead to an understanding of hardening procedures to be adapted in cell manufacture.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0015, BASIC CATHODE STUDIES

R.E. Thomas, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN580202)

The objective is to determine the basic mechanisms that limit the performance of thermionic and secondary emission cathodes such as are used in microwave power tubes. The results of these studies are to be used as a guide for the development of cathodes having greater emission densities and higher reliability.

Modern surface analytic techniques, e.g., SLEEP, LEED, auger and quadrupole mass spectroscopy. Optical absorption, low energy electron loss spectroscopy leels. Photoemission and others are used to study the basic surface properties of state of the art and prototype cathodes. These studies are designed to determine the roles played by atomic structure, chemical composition, evaporation rates, surface dipoles, electronic surface states and absorbed molecules on the thermionic and secondary emission properties of these surfaces.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0016, EXTREME ULTRAVIOLET ENVIRONMENT

C.S. Weller, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN120101)

The exploration, description, analysis, and understanding of the ultraviolet (UV) environment of the earth and space are quite important since, from a fundamental standpoint, the strong optical effects of atoms and molecules occur in this part of the spectrum. This has in the past and will continue in the future to give new insight and opportunities for investigating solar-terrestrial relationships, establishing the behavior of the upper atmosphere and plasmasphere and their interactions, the interstellar medium and its interaction with the solar system, and developing UV space surveillance.

Observational data acquired from NRL instruments on space vehicles such as the STP 72-1, OSO-8, and SOLRAD 11 satellites are analyzed and interpreted. New instrument probes are being developed with emphasis on spectral resolution in the extreme UV and imaging in the far UV.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

4.0017, AERODYNAMIC COEFFICIENT ESTIMATION FROM FLIGHT TEST DATA

E.S. Sears, U.S. Dept. of Defense, Air Force, Armament Lab., *Eglin Air Force Base, Florida* 32542 (DF638490)

Technical management review. To adapt an extended Kalman filter aerodynamic parameter identification algorithm developed by the Analytical Sciences Co. To the Eglin Computer System, improve the program and gain experience in the use of this technique for extracting aerodynamic coefficients

from guided missile flight test data. If the parameter identification algorithm can be successfully implemented it will greatly improve our ability to validate guided missile simulations.

The program will be improved by adding plot routines, a sectional fitting capability and better data input-output routines. A users guide will be written. Computer generated measurement data for missiles such as AIM 9l and AMRAAM will be used to determine the capabilities of the program and the type and quality of flight test data required for analysis. The program will be used to extract aerodynamic coefficients from real flight test data for the GBU-15 and other missiles as the data become available.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Armament Lab.

4.0018, DESIGN AND IMPLEMENTATION OF A NETWORKED AUTOMATED LABORATORY

G.S. Owen, Atlanta University, School of Arts & Sciences, Dept. of Chemistry, *223 Chestnut St. S.W., Atlanta, Georgia* 30314 (NAG 3-113)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

4.0019, STOCHASTIC LANGUAGES AND THEIR APPLICATIONS TO SIGNAL AND IMAGE PROCESSING

K.S. Fu, Purdue University, School of Electrical Engineering, Dept. of Electrical Engineering, *Executive Bldg., West Lafayette, Indiana* 47907 (DN975495; N00014-79-C-0574)

To improve the Navy's surveillance capabilities by developing improved stochastic languages and associated statistical methods for applications to signal and image processing.

Statistical and probabilistic research will be performed to develop improved methods for target identification and texture discrimination of satellite images. In particular, research work will include (1) the investigation of stochastic graphs and stochastic graph grammars for pattern description, (2) the extension of certain inference algorithms to TREE grammars and (3) investigation of stochastic error correcting syntax analysis for TREE languages.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0020, DEVELOPMENT AND FABRICATION OF A FLUIDIC CONTROL SYSTEM FOR THE HYDROFLUIDIC BACK-UP FLIGHT AIRCRAFT

V.F. Neradka, TriTec Inc., *Columbia, Maryland* 21045 (DN890213; N00019-79-C-0457)

To design and fabricate a hydrofluidic, bread board single axis, back-up flight control system to be evaluated for operational feasibility as back-up flying controls for CTOL/V/STOL aircraft.

Based upon the technical data developed in the current study under Navy contract N00019-78-C-0359, and the contractor's proposal no. 122 of 12 March 1979, the contractor will design and fabricate the hydrofluidic components and assemble the single axis back-up flight control system for bench testing. Following bench test, the system will be delivered to the activity doing the evaluation.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0021, MODEL DYNAMICS OF COMPOSITE BEHAVIOR

D.F. Haskell, U.S. Dept. of Defense, Army, Armament Research & Development Command, Ballistic Modeling Div., *Aberdeen Proving Ground, Maryland* 21005 (DA0P4473)

To develop an analytical method for predicting the structural dynamic response of fragment damaged line and panel composite elements subjected to blast loading and design an optimum composite tail boom to survive 30 millimeter HEI projectile.

An optimum structural design technique for helicopter survivability will be developed. Both undamaged and damaged line and panel composite elements will be modeled and their response to blast loading will be calculated. These line and panel elements will then be used to analytically build a composite helicopter primary structural component and study its structural dynamics behavior in the undamaged and damage conditions.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Lab.

4.0022, BALLISTICS TECHNOLOGY-FLIGHT DYNAMICS - EXPLORATORY DEVELOPMENT TESTING - AERODYNAMICS

R.H. Krieger, U.S. Dept. of Defense, Army, Armament Research & Development Command, Ballistic Research Lab., *Aberdeen Proving Ground, Maryland* 21005 (DA0N4426)

This project covers exploratory development tests and applied research programs in the field of aerodynamics and flight mechanics which contribute to the rational design of projectiles, missiles, shell, and rockets. Significant studies undertaken involve the measurement of supersonic and transonic magnus force on non-conical boattails--determine supersonic magnus force on low drag ogive boattail models--probing the transonic boundary layers--obtain total head pressure surveys of the boundary layer on yawed spinning models with boattails--and to perform 3D transonic inviscid flow calculations.

Exploratory development tests and applied research programs are conducted in closed circuit variable density, continuous flow transonic and supersonic wind tunnels as well as in free flight ranges. Theoretical analysis and numerical techniques are also used.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Lab.

4.0023, FLUIDIC SEQUENCER FOR SEAT EJECTION

J.M. Goto, U.S. Dept. of Defense, Army, Electronics Research & Development Command, Harry Diamond Lab., *2800 Powder Mill Rd., Adelphi, Maryland* 20783 (DA0F5580)

To assist in the evaluation/demonstration of the feasibility of utilizing fluidics to obtain longer installed life and improved accuracy and reliability in the sequencing of seat ejection systems.

To assist the Naval Ordnance Station personnel by evaluating contractor designed fluidic circuits and components, attend contractor program reviews, and help study the feasibility of using a 'continuous sensing' mode for aircrew escape system event sequencing.

SUPPORTED BY U.S. Dept. of Defense, Electronics Research & Development Command, Harry Diamond Lab.

4.0024, ENGINEERING METHODS IN PLASMA SCIENCE

H. Lashinsky, University of Maryland, College Park Campus, Inst. for Physical Science & Technology, *College Park, Maryland* 20742 (ECS79-07781)

Research is continuing on non-contact methods of controlling the instability of plasmas. The experimental portion of the research primarily uses the University of Maryland Q-machine for quantitative, experimental investigation of the validity of theoretical models being developed. A number of theoretical and experimental aspects of the problem of stabilizing the drift instabilities of lower-hybrid fields are being investigated. Similar research is being carried out for suppression of ion cyclotron drift instability. Theoretical work also addresses the nonlinear evolution of plasma flute instability to find a mathematical formulation suitable for comparison to experimental results. The final research phase extends the investigation into two ion species instabilities which should be a more realistic representation of experimental conditions in large scale, high temperature fusion plasmas.

This is a continuation of research previously supported under NSF Grant ENG-7702128 A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Electrical Computer & Systems Engineering

4.0025, ROCKET INVESTIGATION OF ELECTRON PRECIPITATION TRIGGERED BY VLF EMISSIONS
D.L. Matthews, University of Maryland, College Park Campus, Inst. for Physical Science & Technology, *College Park, Maryland* 20742 (DPP80-13722)

IN this NSF and NASA jointly-sponsored project, three Nike-Tomahawk rockets will be instrumented with electron spectrometers to study the plasma physics of very low frequency (VLF) wave-particle interactions in the earth's magnetosphere. These rockets will be launched from Siple Station, Antarctica, in conjunction with balloons, satellites, ground-based, and other rocket observations of VLF wave-particle interactions. The analysis and interpretation of the data obtained in this experiment will be done during the second year of this grant.

This project is a continuation of work previously funded under Grant Number DPP 77-22401.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Polar Programs

4.0026, REMOTE TURBULENCE MONITOR
H.C. Steward, H S S Inc., *2 Alfred Cir., Bedford, Massachusetts* 01730 (DN975490; N00014-79-C-0496)

Naval electrooptical surveillance and weapons systems must operate in a turbulent atmosphere. This research is expected to result in a remote sensing device for monitoring this turbulence, and thus, predicting the degradation in systems operation.

The contractor will study the mathematical analysis of a single-ended, double-pass, remote-sensing turbulence measuring LIDAR. The results of this analysis will be used to develop an optimized design for such a LIDAR.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0027, ENERGY CONVERSION - STUDIES OF TRANSONIC TURBINES WITH FILM-COOLED BLADES
J.F. Louis, Massachusetts Inst. of Technology, Div. of Sponsored Research, *77 Massachusetts Ave., Cambridge, Massachusetts* 02139 (DN975229; N00014-79-C-0132)

The objective of this project is to gather the necessary data essential in developing design procedures for high performance, cooled, highly loaded transonic turbine stages. The effort is theoretical and experimental in nature and is aimed at reducing the amount of cooling required per unit of work extracted. The research will contribute to increased performance of gas turbine engines needed particularly for naval aircraft propulsion, but useful as well to marine power plants and fixed installatins.

Study will be made of heat transfer and shock-film interaction in the blade passages, in optimizing performance and design of blade passages, and secondary flow injection. A linear cascade is utilized to test performance of an optimum film cooled blade row, with study of blade shapes, angles of coolant injection, and angle of attack. Emphasis will center on the effect of unsteadiness on the pressure and heat transfer distribution around the blades.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0028, HIGH LEVEL PARACHUTE FORCE TRANSFER DEVICE
M. Gustin, U.S. Dept. of Defense, Army, Natick Research & Development Command, *Natick, Massachusetts* 01760 (DA0H4258)

Establish the design parameters for a coupled height sensor and first-to-second stage deceleration force transfer device for the high level platform airdrop system (HLPADS). The coupled sensor-force transfer device will permit airdrop of heavy equipment from altitudes of 10,000 ft to 25,000 ft above ground level and thereby place the airdrop aircraft out of the range of small surface to air missiles.

Feasibility testing of a complete high level airdrop system using a prototype height sensor-force transfer coupling will be conducted and force data collected to permit establishment of the design parameters.

SUPPORTED BY U.S. Dept. of Defense, Army, Natick Research & Development Command

4.0029, MATERIAL PROPERTY CHARACTERIZATION FOR ANALYSIS OF MILITARY PAVEMENTS
W.R. Barker, U.S. Dept. of Defense, Army, Corps of Engineers, Waterways Experiment Station, *P.O. Box 631, Vicksburg, Mississippi* 39180 (DA0L8185)

To develop methodology for characterizing the structural properties of various types of pavement materials and to formulate this methodology into definitive procedures that will yield quantitative parameters for design of road and airfield pavements using existing or newly developed theoretical and semi-theoretical criteria.

A range of materials that are acceptable for use in CE design of pavements will be considered. Various types of laboratory test procedures will be studied to determine methods of integrating the quantitative output of acceptable laboratory tests with conventional material acceptability standards such as gradation, plasticity, etc. Material characterization procedures will be developed to provide the user with direct and/or indirect methods of obtaining quantitative design parameters.

SUPPORTED BY U.S. Dept. of Defense, Corps of Engineers, Waterways Experiment Station

4.0030, INCOMPRESSIBLE AXISYMMETRIC WAKES
F.R. Hama, Princeton University, School of Engineering & Applied Sciences, Dept. of Mechanical & Aerospace Engineering, *Box 430, Princeton, New Jersey* 08540 (CME78-24177 A01)

This is a continuation of research previously supported under NSF Grant ENG 77-28247 dealing with the instability, vortex formation or shedding, and transition behind an axisymmetric body. The central focus is on the mechanisms within nonlinear stability theory leading to transition to turbulence in axisymmetric flows. During earlier grant periods an elaborate suspension system was constructed to accommodate the necessary critical alignment of the test model. A misalignment of one minute of angle could result in asymmetry of the mean velocity distribution which in turn promotes flow instability. Experiments conducted show features not found in other experiments such as appearance of higher harmonics in the spectra and appears to be associated with a two-dimensional-like travelling wave instead of the helical mode assumed in the current theory. This grant will provide support to complete the stability experiments.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0031, COHERENT ANTI-STOKES RAMAN SCATTERING IN A WAVEGUIDE
R.B. Miles, Princeton University, School of Engineering & Applied Sciences, Dept. of Aerospace & Mechanical Science, *Box 430, Princeton, New Jersey* 08540 (ENG78-11524)

Optical waveguiding techniques are being applied to spectroscopic measurements on adsorbed species and constituents of electric discharges. The technique is based on coherent anti-Stokes Raman scattering and involves use of a tunable dye laser and a frequency doubled neodymium doped yttrium-aluminum-garnet laser. The adsorbed species measurements involve pyridine adsorbed to alumina slabs that form the walls of a tapered waveguide. The discharge work involves the diagnostics of fast recombining plasma-excited species in a hollow waveguide containing a pulsed transverse electric discharge.

This is a continuation of research previously supported under NSF grant ENG-7709283.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0032, WA01 - ACOUSTIC SENSOR
R. Dikant, U.S. Dept. of Defense, Army, Armament Research & Development Command, Fire Control Div., *Picatinny Arsenal, Dover, New Jersey* 07801 (DA0B0723)

To determine the feasibility of utilizing an airborne acoustic sensor to detect and acquire both airborne and ground threat vehicles.

Conduct a flight test to map the near field noise of an AH-1 Cobra aircraft. Analyze the noise field data to determine the optimum position for mounting acoustic sensors on the airframe to enhance system performance potential.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Fire Control & Small Caliber Weapon Systems Lab.

4.0033, MODULAR ENGINE TEST TECHNIQUES
D. Croce, U.S. Dept. of Defense, Navy, Naval Air Engineering Center, *Lakehurst, New Jersey* 08733 (DN096113)

Develop propulsion support test requirements and equipment for testing modular engine components as well as investigate procedures and requirements for testing and identification of candidate configurations.

Navy problems and needs related to modular engine tests will be addressed from an analytic point of view. Technology from engine/airframe manufacturers, other military branches and rework facilities will be investigated. Modular engine technology will be applied, diagnostic/automation method will be integrated, trade-off studies will be conducted and candidate configurations will be defined for further development. Basic requirements for future V/STOL engines will be established.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0034, ANALYSIS OF GAS TURBINE ENGINE EXHAUST EMISSION VARIABILITY
A.F. Klarman, U.S. Dept. of Defense, Navy, Naval Air Propulsion Test Center, *1440 Pkwy. Ave., Trenton, New Jersey* 08628 (DN796898)

Determine the variation of engine exhaust emission levels within engine models, with increased engine operating time, with the introduction of smokeless combustors, and with respect to test cell operational variables. Estimate the number of engines required for a statistically reliable sample.

Measure emissions from a number of gas turbine engines of the same model and type before and after overhaul, and with and without smokeless combustors. Test one engine four times and measure test cell operational variables. One model of a turbojet, turbofan and afterburning engine will be tested.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Material Command

4.0035, PORTABLE LIGHTWEIGHT UPPER-AIR SOUNDING (PLUS) SYSTEM
A.A. Duff, U.S. Dept. of Defense, Army, Electronics Research & Development Command, Atmospheric Sciences Lab., *White Sands M.R., Las Cruces, New Mexico* 88002 (DA0D2273)

To devise a tracking system to obtain upper air meteorologicl sounding data (rawinsonde) for the army's combat artillery elements more easily than current practices involving the GMD-1 () rawin set. The new system is to equal or surpass the GMD-1 () performance, be smaller, lighter in weight, and to incorporate fully automated computer data processing.

Use will be made of 'aircraft' type construction to obtain best stiffness to weight ratio in the mechanical portion of the tracker. We will utilize the electrical advantages inherent in monopulse antenna designs and will utilize, if necessary, computer control of the tacking characteristics of the elevation over azimuth antenna mount. Incremental stepper motor drives for azimuth and elevation will be utilized so that the axes of rotation will be automatically locked in position during periods of no input (null) from the tracking circuitry. This feature combined with direct optical encoding of the angles of the axes will minimize parts and maintenance.

SUPPORTED BY U.S. Dept. of Defense, Electronics Research & Development Command, Atmospheric Sciences Lab.

4.0036, TRANSONIC TURBOMACHINERY INLET CONDITIONS
W.J. Rae, Calspan Corp., *1422 Genesses Ave., P.O. Box 235, Buffalo, New York* 14221 (DN890139; N000019-78-C-0603)

To develop methods for treating inlet conditions in transonic turbomachinery flow field calculations.

Theoretical study.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0037, A COMPUTER SIMULATOR FOR A MOBILE TELEPHONE SYSTEM
D.L. Schilling, City University of New York, City College, School of Engineering, Dept. of Electrical Engineering, *Convent Ave. & 138th St., New York, New York* 10031 (NAG 3-119)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Lewis Research Center

4.0038, MICROSTRUCTURES SCIENCE AND TECHNOLOGY
E.D. Wolf, Cornell University, Ithaca Campus, School of Engineering, Dept. of Electrical Engineering, *242 Carpenter Hall, Ithaca, New York* 14853 (INT79-16879)

This award will support the efforts of Professor Edward D. Wolf of Cornell University in Ithaca, NY who, with U.S. colleagues, will spend a total of about six weeks with Professor Susumu Namba of Osaka University in Japan to establish a technical information exchange between the National Research and Resource Facility for Submicron Structures at Cornell and the Microfabrication Research Laboratory at Osaka. The research opportunities in microstructure science, engineering, and technology are substantial and extend well beyond silicon integrated circuit technology. This project will advance this interdisciplinary field of study by enabling scientists to exchange ideas and methodology in the areas of electron beam lithography, submicron pattern transfer, molecular beam epitaxy techniques of film growth, X-ray lithography, high brightness electron and ion sources, electron and ion optics, and beam interaction on solid surfaces. This project is sponsored jointly by NSF and by the Japan Society for the Promotion of Science under the U.S.-Japan Cooperative Science Program.

SUPPORTED BY U.S. National Science Foundation, Directorate for Scientific Technological & Internat. Affairs, Div. of International Programs

4.0039, C-LAYER PROPAGATION FOR LONG WAVE COMMUNICATIONS/NAVIGATION
J.E. Rasmussen, U.S. Dept. of Defense, Air Force, Rome Air Development Center, *Griffiss Air Force Base, Rome, New York* 13441 (DF904010)

AF function - communications, navigation and detection in the long wave radio spectrum. Deficiency/opportunity - improve the range and reliability of VLF/LF communications. Improve the accuracy, predictability, and reliability of VLF (OMEGA) navigation systems. Objective - to evaluate the significance of the lower ionosphere's C-layer on long wave electromagnetic propagation technology for Air Force communications, navigation and detection systems. How research contributes - provides the experimental measurements and theoretical modeling required to understand long wave radio propagation and to determine the engineering parameters critical to VLF/LF system design.

The propagation of VLF and LF radio waves is primarily a function of the reflectivity of the lower ionosphere. The exis-

tance and influence of the C-layer in VLF/LF propagation is an extremely controversial subject with the only direct observations being a very limited sample obtained by RADC/EEP at mid-latitude. Under this work unit C-layer measurements will be conducted utilizing RADC/EEP's high resolution ionosounder to verify the existence of a descrete layer in polar regions and determine the diurnal stability of C-layer propagation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0040, VLF/LF IONOSPHERIC PROPAGATION
J.E. Rasmussen, U.S. Dept. of Defense, Air Force, Rome Air Development Center, *Griffiss Air Force Base, Rome, New York* 13441 (DF904180)

AF function - communications, navigation and detection in the long wave radio spectrum. Deficiency/opportunity - improve the range, reliability and survivability of VLF/LF communications. Improve the accuracy, predictability and reliability of VLF (Omega) navigation systems. The objective is to originate and develop new long wave electromagnetic techniques which will significantly advance ionospheric radio propagation technology for Air Force communications, navigation and detection systems. This work will emphasize the evaluation and improvement of VLF and LF air-to-air system survivability in a nuclear environment. How research contributes - provides the experimental measurements and theoretical modeling required to understand long wave radio propagation under normal as well as severely disturbed ionospheric conditions and to determine the engineering parameters critical to VLF/LF system design.

The signal strength or coverage area for VLF and LF radio waves as a function of altitude is a critical propagation parameter for the design and evaluation of af long wave systems. Under this work unit a theoretical and experimental program will be conducted to determine the energy distribution of TE and TM polarized waves with altitude. This study will utilize balloon-borne dartsonde packages, rocket payloads and instrumented aircraft to measure both signal and noise as a function of polarization. The primary factor which controls the altitude distribution, and long wave propagation in general, is the reflectivity of the lower ionosphere which will also be studied utilizing a high resolution pulse ionosounder located in the arctic, where solar related particle events provide the best available simulation of the low altitude absorption features expected in a nuclear environment.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0041, TACTICAL TARGET IDENTIFICATION SIMULATION
R.J. Wood, U.S. Dept. of Defense, Air Force, Rome Air Development Center, *Griffiss Air Force Base, Rome, New York* 13441 (DF742110)

The purpose of this effort is to develop a TTI (tactical target identification) simulation capability to evaluate specific radar identification techniques (RCS, Doppler, imaging). This in-house effort will provide a means for evaluation and focus of the TTI contractual program as well as serve as a vehicle to demonstrate this technology to users.

The technical approach to the TTI simulation program will be to instrument the TTI laboratory with the appropriate computing power. This shall be realized with existing government-owned equipment and integrating the necessary peripherals. The necessary data processing algorithms will be developed on this system in conjunction with contractor-furnished software and applied to the demonstration of interactive aircraft identification and classification functions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0042, AUXILIARY POWER UNIT (APU) LABORATORY
P.G. Colegrove, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF458270)

To develop and operate an in-house capability to test either contractually developed APU components or develop new APU concepts, to provide quick reaction response to requests for technical assistance and problem solution from using Air Force organizations such as SPO's and other laboratories.

Build and maintain suitable laboratory facilities for conducting tests on APU components or concepts.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0043, TURBINE ENGINE CONTROL SYSTEM DEVELOPMENT (IN-HOUSE)
L.L. Small, U.S. Dept. of Defense, Air Force, Aero Propulsion Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF451970)

The objective of this in-house effort is two fold- to develop, fabricate and test high response turbine engine sensors so vitally necessary for advanced propulsion system control, and using this instrumentation as an input and a digital computer as processor, to develop and evaluate new control modes including optimal control techniques for the complex, multi-input and multi-output turbine engine control systems of the future.

The technical approach to this in-house effort consists of several interrelated tasks- (1) development of an analog and digital data acquisition/reduction capability for an engine test cell, (2) development, fabrication, and experimental evaluation of high response gas turbine engine sensors for possible control system applications, (3) analysis of various digital J-85 engine models and updating of these models from actual engine test data, (4) evaluation of classical control schemes with emphasis on closed loop control of unique engine parameters such as compressor discharge corrected airflow and turbine inlet gas temperature, and (5) the evaluation of modern control theory (i.e., using the state variable plant representation) as applied to actual engine control.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aero Propulsion Lab.

4.0044, RECONNAISSANCE AND WEAPON DELIVERY DIVISION SENSOR SYSTEM AND IMAGE ANALYSIS
E.L. Gliatti, U.S. Dept. of Defense, Air Force, Avionics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF093550)

To process, maintain, and develop methods and applications of performing reconnaissance and/or weapon delivery related sensing system evaluations. Included in this are digital and analog computer analysis of flight environment and simulation, and microdensitometer and/or special equipment to perform imagery/display evaluations. These efforts are directed toward economically analyzing system and subsystem performance prior to flight and post-mission analysis and to various advanced imagery/display evaluation techniques such as edge analysis for determinatcn of resolution capabilities.

This effort utilizes several advanced computer programs for processing vibration and rate gyro info into frequency spectrums, time amplitude, statistical analysis, and other analytic techniques useful in determining the environment of a reconnaissance or weapon delivery sensor and simulating this combined motion for flight performance prediction. Also, other special computer program process scanned imagery/display to develop the statistical results sufficient to evaluated imagery/display quality. This work unit additionally covers the maintenance and improvement of equipment and software.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0045, OPERATION OF PARACHUTE DATA BANK FOR WEAPONS SYSTEM DESIGN APPLICATION
J.H. Deweese, U.S. Dept. of Defense, Air Force, Flight Dynamics Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF132370)

A significant amount of parachute design and performance data associated with military systems applications has been and is continuing to be generated which does not become available to the technical community due to inadequate data reporting and a lack of any rapid access system for parachute performance data. A parachute data bank has been established to cir-

cumvent these problems. The objective of this program is to maintain the currency of the bank of parachute design and performance data and expand the data base through the extraction, analysis and storage of pertinent data and information on gliding and supersonic parachute systems. This expansion of the data base will significantly improve and broaden the services the data bank can render for the expeditious design and performance prediction of parachute systems for emergency crew escape, tactical air drop, weapon deceleration and aerospace vehicle recovery applications.

Feasibility studies will be conducted by the contractor to select the best proposed design concepts for further refinement. One or two best designs will be fabricated as laboratory breadboards and subjected to laboratory test and evaluation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0046, RIGOROUS ANALYTICAL THEORY FOR BOUNDARY-FREE INCOMPRESSIBLE FLUID AND HOMOGENEOUS TURBULENCE

G.H. Rosen, Drexel University, School of Science, Dept. of Physics & Atmospheric Science, *32nd & Chestnut Sts., Philadelphia, Pennsylvania* 19104 (NAG 1-110)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

4.0047, DEVELOPMENT OF HUMAN FACTORS ENGINEERING DATA AND METHODS FOR ADVANCED AIRBORNE SYSTEMS, EXPLORATORY (BLOCK PROGRAM)

P.M. Curran, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN681086)

To develop and apply required data and effective methods to achieve effective integration of operators and maintainers with weapon systems to insure optimum performance of mission-related tasks throughout the entire life cycle of airborne systems.

This program involves four general task areas: (1) visual displays and manual controls, (2) data base for design criteria, (3) weapon systems design, and (4) technology application. The approach applicable to all task areas is: (a) identify critical subtask areas, (b) identify availability and adequacy of relevant data and methods for: (1) projected goals and applications, (2) defining requirements, (3) implementation of requirements, and (4) evaluation of implementation, (c) determine deficiencies, criticalness and solution likelihood, (d) conduct required exploratory development efforts, (e) conduct appropriate validation and/or feasibility demonstrations, and (f) either modify development approach or terminate effort of transition to advanced development.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0048, JET/AERODYNAMIC SURFACE INTERFACE MODEL FOR V/STOL AIRCRAFT

K.T. Yen, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN081480)

To conduct analytical and experimental investigations of the aerodynamics of a fet in a crossflow for the purpose of developing aerodynamic prediction methods for V/STOL aircraft in low speed and transition flight.

An analytical and experimental research program will be conducted jointly by the NAVAIRDEVCEN - Dr. Yen, the University of Tennessee - Dr. A. J. Baker and the University of Florida - Dr. R. L. Fearn. Experimental work will be conducted by Dr. Fearn at the NASA/Ames V/STOL wind tunnel using LDV and other probes to study the aerodynamic structure of a FET in a crossflow. The experimental results will be correlated with analysis and modeling work to be carried out by Drs. Yen and Baker. The experimental and analytical phases of this work will be coordinated by Dr. Yen to ensure that appropriate experimental and measurement procedures are followed and to establish a sound basis for the development of the analytical model S.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Material Command

4.0049, ADVANCED AERODYNAMIC CONCEPTS

K.T. Yen, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN481077)

To conduct research in promising areas of advanced aerodynamics, i. e., technologically efficient areas of unique interest to the U.S. Navy.

Through continuing review of the aerodynamics S.O.A. Identify areas of significant technological deficiency and establish priorities based upon Navy unique requirements, impact on operational effectiveness, economy of development and solution risk. See qualified sources to perform the work, administer study contracts and provide in depth technical monitoring and overall program management. Some work is also performed on contract as reported in work units NN701B6, NN701B10 and NN701B11.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

4.0050, DEVELOPMENT OF ADVANCED AIRBORNE EXECUTIVE PROGRAM

C. Czaplicki, U.S. Dept. of Defense, Navy, Naval Air Development Center, Software & Computer Directorate, *Warminster, Pennsylvania* 18974 (DN881066)

Distributed computer configurations have been projected as the next generation architecture for various avionic platforms. The objective is to explore and develop new approaches for airborne executive programs to handle these configurations. The goal is an executive design which will meet the requirements of the various platform (P3, S3A, V/STOL aids) configuration and which will provide increased reliability graceful degradation and expanded processing capability.

The approach of this effort will be to critically review project requirements and investigate alternate new approaches to the executive design. There has been little work done on multicomputer executives in the time-critical airborne environment with its associated peripheral equipment constraints. Items to be investigated are error recovery, task scheduling, processor communications and other related areas.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Development Center

4.0051, RESONANCE LIGHT SCATTERING BY NON SPHERICAL INHOMOGENEOUS OBJECTS

P.W. Barber, Utah Higher Education System, University of Utah, School of Engineering, Dept. of Electrical Engineering, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (ENG77-20447)

The Extended Boundary Condition Method will be used to calculate the scattering and absorption characteristics of individual layered nonspherical dielectric objects. Extensive testing of the method will be accomplished to determine its range of validity as well as any limitations on its application. Numerical calculations will then be made for a general class of objects to investigate the effects of layered inhomogeneities on the scattering and absorption by nonspherical dielectric objects. One focus of interest in this work will be the examination of general validity rules for the widely used Rayleigh-Gans-Debye approximation.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science

4.0052, AIR CUSHION VEHICLE SKIRT MATERIAL INVESTIGATION

P.D. Touchet, U.S. Dept. of Defense, Army, Mobility Equipment Research & Development Command, Marine Div., *Fort Belvoir, Virginia* 22060 (DA0N3627)

To extend the life and associated cost of these components which drag over land and sea, it is planned to investigate materials and processes more suitable to the severe wear they must

endure. Current life is approximately 350 hours of operation. A target life expectancy will be 600 hours.

It is planned to determine results of prior efforts by both the United States and foreign investigators, including the National Research Council, on material application to air cushion technology. Then using this Command's expertise in fabrics for oil, inflatable boats, etc., applying that experience to realize the above technical objective by physically testing on the only active air cushion vehicle in the United States government, the LACV-30. (Based on the approach by the US Navy and Bell Aerospace to use a composite material of rubber coating on nylon, MERADCOM plans to investigate the use of a thermoplastic urethane with and without a nylon backed composite. Three experimental cushion fingers of each of three MERADCOM composite materials will be procured and installed on the LACV-30-2. It is planned to log 300-400 hours of wear on these experimental materials and then evaluate.

SUPPORTED BY U.S. Dept. of Defense, Mobility Equipment Research & Development Command, Marine Div.

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, A THEORETICAL STUDY OF SUBSTORM PROCESSES

J.R. Kan, University of Alaska, Fairbanks Campus, Geophysical Inst., *Fairbanks, Alaska* 99701 (ATM79-16470)

This grant continues a theoretical study of magnetospheric substorm processes with greater emphasis on treating the solar wind and magnetosphere as a single interactive system. With this in mind, an examination of a number of specific projects in each of the following interrelated problem areas will be undertaken: (1) Solar wind-magnetosphere interaction; (2) plasma sheet structures and dynamics; and (3) magnetosphere-ionosphere coupling.

The research is a coherent theoretical program of the Substorm Study Group of the Geophysical Institute. The specific projects, singled out for immediate study, are chosen to achieve quantitative understanding of three fundamental processes of magnetospheric substorms. First, the solar wind dynamo process will be studied as a possible mechanism for transferring energy from the solar wind to power substorm activities. Second, the current interruption process in the magnetotail will be studied as a possible mechanism for substorm onset. Third, the source mechanism for field-aligned auroral sheet currents will be studied in connection with the auroral arc formation process.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0002, ANTARCTIC ATMOSPHERIC INFRASOUND

C.R. Wilson, University of Alaska, Fairbanks Campus, Geophysical Inst., *Fairbanks, Alaska* 99701 (DPP77-22997)

Observations of auroral infrasonic waves (AIW) will be carried out at Windless Bight near McMurdo Station, Antarctica, using a four-microphone array. Data from the microphone array will be collected at a central point and telemetered to Scott Base where it will be recorded in digital form on chart recorders and on slow-speed magnetic tape.

During the second year of this grant, the AIW data, along with riometer, magnetometer, and all-sky camera data collected at Scott Base, will be used to investigate how auroral infrasonic waves are generated.

Logistics support is required for one person at McMurdo.

Previous award number is DPP-7305897 A03 (Proposal Number DPP-7719091).

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Polar Programs

5.0003, MOVING BASE GRAVITY GRADIOMETER

R.L. Forward, Hughes Aircraft Co., *3011 S. Malibu Canyon Rd., Malibu, California* 90265 (DF277690; F19628-76-C-0107)

AF function - inertial navigation and missile guidance. Deficiency - inadequacy of existing gravity models and gravimetrically unsurveyed areas, downgrade inertial navigation and guidance accuracy. Objective -modify the prototype moving base gradiometer and fabricate an additional gradiometer. How research contributes - data collected by a moving base gradiometer will improve knowledge of the geoidal form.

VHF and UHF signals are recorded and analyzed by grantee. Signals from DNA satellite and INTERCOSMOS 14 will be recorded for the first time. Analyses and reduced data are delivered to AFGL for inclusion into models being constructed for systems usage. The work is done in conjunction with the joint satellite studies group, and is important for differentiating between polar and auroral effects.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0004, A PROPOSAL TO USE AVHRR DATA FOR MEASUREMENTS OF ATMOSPHERIC AEROSOLS

M. Griggs, Science Applications Inc., Remote Sensing Division, *1200 Prospect St., La Jolla, California* 92037 (8-683; M0-A01-78-00-4092)

OBJECTIVE: Develop a technique to infer atmospheric aerosol particle concentration over the earth's oceans using measurements of reflected solar radiation from the Advanced Very High Resolution Scanning Radiometer (AVHRR) on the TIROS-N series of satellites. Use this technique to produce maps of aerosol particle concentration.

APPROACH: Measurements of the radiance of reflected solar radiation over cloudless ocean areas are entered into a table look-up procedure which, for the particular solar incidence angle and AVHRR viewing angle, returns an estimate of the aerosol particle content of the atmosphere. This result will be adjusted by factors, derived empirically from ground truth experiments, to correct for regional differences in the physical and chemical properties of aerosol particles.

A ground truth experiment will be conducted several months after the successful launch of NOAA-B. The contractor will perform the following tasks: (1) plan NOAA B global ground truth experiment in collaboration with NOAA personnel; (2) make ground truth measurements of the aerosol optical thickness at San Diego for a period of three months and relate to NOAA-B radiance data; (3) analyze data for three months from one other selected site and compare with the San Diego data.

PROGRESS: A ground truth experiment was conducted from July -September, 1979, at 12 ocean coastline stations. Unfortunately, due to the late launch of NOAA 6, the low priority given to its AVHRR data and the presence of low clouds during the early morning hours of the satellite pass, only 18 cases were obtained for analysis. These cases are currently being analyzed under this contract.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Environmental Satellite Service

5.0005, ORIGINS AND BEHAVIOR OF POLLUTION AEROSOLS

S.K. Friedlander, University of California, Los Angeles Campus, School of Engineering & Applied Science, Dept. of Chemical Nuclear & Thermal Engineering, *405 Hilgard Ave., Los Angeles, California* 90024 (R806404-02; GC20 -0588)

OBJECTIVE: To investigate the formation of nitrate and organic compound containing aerosols in an experimental laboratory situation; to test the aerosol theory developed by the principal investigator for the nitrate and organic aerosols.

APPROACH: Balloon reactor studies will be carried out for nitrates and organics. Atmospheric air will be spiked with PPM levels of NOx, propylene and ammonia. Size distribution of aerosols formed and the nitrate aerosol formation rate determined.

PROGRESS: Grant began 1/4/79. Laboratory equipment has been assembled and experimental studies will begin.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

5.0006, RADIOWAVE DIAGNOSTIC STUDIES OF THE EARTH'S PLASMA ENVIRONMENT

V.H. Rumsey, University of California, San Diego Campus, Graduate School, Dept. of Applied Physics & Information Science, *P.O. Box 109, La Jolla, California* 92037 (ATM78-06770)

This grant will use the technique of interplanetary scintillation (IPS) to probe the solar wind in regions normally inaccessible to spacecraft. This technique allows an estimate of the solar wind velocity (and its random component) and the spatial spectrum of electron density. An observatory consisting of three widely spaced antennas operating at 74 MHz has been set up under previous NSF grants. It is well suited to measuring IPS at solar distances of 60 to 250 solar radii (Ro). In this range it is possible to concentrate on high latitudes observations.

The observations outside of 60 Ro will be regular and continuous. Thus they will be used to study the latitude structure of streams and by comparison the latitude structure of the corona. As the solar activity increases and transients become increasingly important, it will also be possible to map the spatial structure of these events. Observations inside 60 Ro are more complex because the solar wind is more variable. However, by using multiple antennas and/or multiple frequencies the velocity and spatial spectrum can be reliably estimated. The basic objective is to study the development and evolution of turbulence in the acceleration region of the solar corona as it expands to become the solar wind.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0007, THE ABUNDANCE OF THE ELEMENTS

H.E. Suess, University of California, San Diego Campus, Graduate School, Dept. of Chemistry, *P.O. Box 109, La Jolla, California* 92037 (NAGW 103)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

5.0008, ATMOSPHERIC SCATTER STUDIES

B.B. Balsley, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8DJ42853)

PROJECT OBJECTIVE: To investigate various parameters of the Atmosphere/Ionosphere system that can be examined by radar techniques.

CURRENT YEAR PLAN: Typical investigations include studies of neutral atmospheric parameters using high-powered radar systems in Alaska, Puerto Rico, and Peru. Additional studies include ionospheric irregularities arising from natural and man made causes.

PROGRESS REPORT: Existing data show that VHF radars can be used to examine the atmosphere in the complete height range 1-100 km. Comparisons between radar wind data and rawinsondes in Puerto Rico and Alaska show that these radars can accurately measure the wind. Construction has begun on a large phased-array radar system in Alaska to examine the height range 1-100 km on a continuous basis.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0009, ATMOSPHERIC RESEARCH SUPPORT

C.F. Chappell, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8G130522)

PROJECT OBJECTIVE: Study of physical and chemical processes in the atmosphere to advance the understanding and prediction of mesoscale weather phenomena. Research the interactions of radiation with microphysical properties of particulate matter.

CURRENT YEAR PLAN: Conduct diagnostic and theoretical studies of and develop numerical models of mesoscale and microphysical processes. Identify effects of aerosols on mesoscale weather and climate.

PROGRESS REPORT: Carried out several research programs to further the objectives of this project. These included the clear air turbulence project and the atmospheric chemistry and mesometeorology programs.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0010, EDF/RADAR

D. Haugen, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8AA78585)

PROJECT OBJECTIVE: Establish both conventional and Doppler weather radar data ingest capability for PROFS Exploratory Development Facility (EDF). Develop software packages for integration with satellite and surface data to obtain nowcast/forecast products.

CURRENT YEAR PLAN: Establish hardware/software interfaces between National Weather Service conventional radars at Limon, Colorado, Cheyenne, Wyoming, and the data acquisition system within the PROFS EDF.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0011, MESA INSTEP

J.W. Kofoed, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (87127719)

PROJECT OBJECTIVE: To conduct basic research as required by applied studies in the N.Y. Bight; to investigate problems confronted by the research community at large. Specific objectives pertain to determining sediment distribution, sediment flux, and substrate aggradation and degradation in the New York Bight.

CURRENT YEAR PLAN: Work on this project will be limited to the production of two products (from existing data): 1) an analysis of the suspended matter transport in the Hudson Estuary Plume, and 2) a climatological model of sediment transport in the New York Bight.

PROGRESS REPORT: During FY-80, AOML/MG&GL conducted an ambitious field program in the N.Y. Bight to support the MESA/INSTEP Program. Highlights included: (1) suspended sediment/nephelometry data collected regularly throughout the year (approximately monthly) at 40 stations along six different transects; (2) several successful instrument deployments made including: CV and BCV probes, Marsh-MC Birney current meters, time-series water sampler, and BLIP; (3) sidescan sonar/bottom sampling operations successfully conducted.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0012, THERMAL OBSERVATIONS FOR OTEC

G.A. Maul, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (B3333310)

PROJECT OBJECTIVE: To assess selected ocean areas for thermal resources by means of standard in situ procedures and satellite technology in order to establish the applicability of these areas for the siting of an ocean thermal energy conversion plant.

CURRENT YEAR PLAN: Continue data collection and analysis in the South Atlantic and Gulf of Mexico, and monitoring of effort at Puerto Rico and Hawaii. In conjunction with these, continue the evaluation of satellite remote sensing for OTEC environmental resource and impact assessment.

PROGRESS REPORT: Data from the Mobile site suggest that this does not possess adequate resource to justify further observations at this time while the Tampa data indicate the thermal resource here is somewhat larger. Two cruises were completed in the tropical South Atlantic and an additional one is planned. A complicated sea surface temperature distribution and wave conditions more severe than expected were found. Maps using the GOES satellite digital file, of sea surface temperature over the Gulf of Mexico at 10 km resolution are in process.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0013, STRATOSPHERIC MEASUREMENT

A.L. Schmeltekopf, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8DJ44083)

PROJECT OBJECTIVE: Conduct an experimental program to monitor the long-term changes in the concentrations of stratospheric constituents which are found to have the potential for upsetting the stratospheric ozone balance.

CURRENT YEAR PLAN: A comprehensive critical species measurement program will be continued to obtain altitude profiles, study temporal variations (both systematic, e.g. seasonal, solar cycle, etc. and non-systematic of at least non-correlated variations) and study geographical variability. Several techniques will be used to carry out this program (i.e. grab samples, flyable Gas Chromatograph, resonance fluorescence, optical absorption and laboratory rate constant measurements).

PROGRESS REPORT: We have made four grab sample balloon flights from Antarctica, Brazil and Wyoming. These were analyzed for N2O, F-11, F-12, and CH4, four balloon flights were made measuring H2O, one from Brazil, the rest in Wyoming. These measurements are the highest resolution, most reliable H2O measurements made to date and will have considerable influence on our thinking about transport of gasses in and out of the stratosphere. On all of the above flights, O3 was measured and is a great aid in the interpretation of the data.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0014, DOPPLER RADAR DEVELOPMENT

R.G. Strauch, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8C370160)

PROJECT OBJECTIVE: Design, assemble, and test Doppler radar systems for use in meteorological studies. Develop methods of processing Doppler data in a form useful for meteorological analysis. The long-term goal is to develop a real-time display of velocity fields.

CURRENT YEAR PLAN: Add field processing capability to system. Incorporate state-of-the-art pulse-pair processing system, better receivers and new magnetrons. Develop complete computer simulation for multi-Doppler error analysis.

PROGRESS REPORT: Multiple-state Doppler software documented and published in NOAA report. Air trajectory computation and topographic lower boundary incorporated into multi-Doppler software. Two options for ground-cluster suppression included. Under FAA sponsorship, an air traffic control radar was modified by clear-air wind measurements under WPL supervision.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0015, CLOUD SENSING RADAR

R.G. Strauch, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab., *Boulder, Colorado* 80302 (8AA72362)

PROJECT OBJECTIVE: Develop short wavelength radars for cloud sensing and determine their utility in operational mesoscale forecasting.

CURRENT YEAR PLAN: Continue development of an 8mm wavelength scanning Doppler radar for cloud sensing. Develop processing and display system for 8mm radar.

PROGRESS REPORT: Data acquired in the Phoenix experiment by the vertically pointing TPQ-11 were analyzed and reported. Major parts of the 8mm scanning Doppler radar were completed. A forward scatter experiment was carried out between Brighton and Boulder that produced the first observed spectra of refractive index within clouds.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., Environmental Research Lab.

5.0016, LIDAR MEASUREMENTS OF AEROSOLS

K.M. Haught, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN980205)

To measure the optical properties of atmospheric aerosols using laser radar (LIDAR) techniques. Lidar systems are being considered for a variety of remote sensing applications, and this effort potentially offers a methodology for extending LIDAR techniques to include aerosol monitoring.

A prototype LIDAR will be assembled by combining existing NRL components with a ND-YAG laser operating at 1.06 micrometers. The prototype will be constructed to be compatible with NRL/S double-ended aerosol particle-size-distribution spectrometers. Additionally, a BIOMATION model 8100 waveform analyzer will be integrated with a NOVA 1210 mini-computer.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Ocean Systems Center

5.0017, REGRESSION ESTIMATION OF THE PROBABILITY OF TROPICAL CYCLONE RECURVATURE

P.W. Leftwich, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Hurricane Center, *P.O. Box 248286, Coral Gables, Florida* 33124

OBJECTIVE: Statistical techniques to aid the early identification of recurvature events will be developed separately for the Atlantic and Eastern North Pacific tropical cyclone basins.

APPROACH: Regression equations to estimate the probability of tropical cyclone recurvature will be developed. Selected predictors will reflect climatology, persistence, and predicted deep-layer mean geopotential heights for the 1000-100 millibar layer. Cases for which initial storm motion is between south (180 degrees) and west-northwest (315 degrees) will be considered. Recurvature, as defined for the purposes of this study, occurs during the forecast period when (1) net northward storm displacement is greater than net westward displacement, (2) there is a net eastward displacement, or (3) the storm acquires an easterly component of motion during the last 12 hours of the period. Forecast periods are 36 and 72 hours.

PROGRESS: Work has progressed on Atlantic tropical cyclones. Tests are being conducted with both linear and linear-logistic probability models. Encouraging results have been obtained with a linear-logistic model based on perfect-prog predictors selected from deep-layer mean geopotential heights. Refinements will be made to the Atlantic techniques. This work will be extended to the Eastern North Pacific basin.

SUPPORTED BY U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Weather Service

5.0018, ANALYSIS OF LAND USE PRACTICES AND POLICIES FROM LANDSAT DATA

C.W. Pannell, University of Georgia, School of Liberal Arts, Dept. of Geography, *Athens, Georgia* 30601 (SOC77-27701)

Information related to land use/land development projects of modern China is largely limited to government and visitor reports which seldom indicate spatial distributions or provide solid data by which the success (or failure) of planning policies can be measured. This research will employ recent LANDSAT-1 and -2 satellite image data in conjunction with supplementary information to map, analyze and compare the urban and rural land use patterns in seven selected regions of China known to

have undergone significant change since 1949. Specifically, the study areas include: (a) Northeast and Borderlands; (b) North China Plain; (c) Huang Ho Basin; (d) Central Yangtze and Lakes Basin; (e) Pearl River Delta; (f) Sinkiang; and (g) Tibet. LANDSAT data and supplementary maps, photographs and reports are available for these study areas and previous investigations by the authors have demonstrated the feasibility of conducting regional land use studies of China from satellite data. It is anticipated that the regional studies and interregional comparisons will permit an objective assessment of Chinese planning goals and achievements.

SUPPORTED BY U.S. National Science Foundation, Directorate for Biological Behavioral & Social Sciences, Div. of Social & Economic Sciences

5.0019, SPECTRAL PROPERTIES OF ICE-MINERAL MIXTURES

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SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

5.0020, REMOTE SENSING OF CURRENTS

W. Scherer, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Ocean Survey, Engineering Development Lab., Sensor Development Branch, 6001 Executive *Blvd., Rockville, Maryland* 20852 (CE1000/86221300)

OBJECTIVE: Verify the applicability of acoustic Doppler backscatter techniques to the remote sensing of currents at fixed locations. *Develop and verify a body of theory describing* Doppler shift mechanisms of the acoustic scatterers involved. Generate functional engineering specifications with system limitations.

APPROACH: Operate a single-channel feasibility model of an acoustic remote measuring device to collect data for analysis *and evaluation.*

Survey existing theoretical scattering models and develop new models where necessary to describe the volume scattering *process as a function of environmental parameters. Determine,* through experiments, information within the Doppler shifted signals which must be extracted to realistically estimate the water velocity.

PROGRESS: Field testing for single channel feasibility has been conducted. Data analyses were summarized at the 98th meeting of the Acoustical Society of America held at Salt Lake City, UT in a paper entitled 'An Intercomparison of an Acoustic Remote Current Sensor and Aanderaa Current Meter in an Estuary.' A documentation inventory has been established which contains field datasets, hardware schemes, project reports *and articles from the published literature.*

SUPPORTED BY U.S. Dept. of Commerce, National Ocean Survey, Engineering Development Lab.

5.0021, SEVERE LOCAL STORM PREDICTION - *SHORT-RANGE FORECASTING*

M.A. Alaka, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Weather Service, Systems Development Office, Techniques Development Laboratory, *8060 13th St., Silver Spring, Maryland* 20910 (8C378102)

OBJECTIVE: *To develop and implement operationally* automated techniques for producing timely and accurate probability forecasts of thunderstroms, severe thunderstorms, tornadoes, *and heavy convective rainfall up to 6 or 12 h in advance.* Sophisticated models incorporating both numerical model output and various types of observed data will continue to be *implemented at NMC. The forecasts will be transmitted to* NSSFC, NWS forecast offices, and FAA stations by teletype and the AFOS system. Simpler objective forecasting systems, to update centralized forecasts based entirely upon MOS, will be developed and implemented at a few forecast offices or centers where adequate computer resources are available. Models implemented at NMC would usually produce forecasts at any time the need arises.

APPROACH: A combination of classical statistical and MOS techniques will be used to develop the forecast models. The sophisticated models will draw predictive information from conventional appropriately-analyzed surface and upper air data, digital radar data, numerical model output, and climatology of the predicted event. More simple on-station models will be designed to update centralized MOS forecasts in a very timely fashion. Input to these on-station models will include MOS forecasts and all types of useful observed data (conventional surface and upper air, digital radar, and possibly satellite data) after appropriate analyses are applied.

PROGRESS: New summer season 2-6 h thunderstorm and severe local storm prediction equations, implemented in June 1979, are currently operational. Probability forecasts for these elements are being transmitted to NWS field offices four times daily. Specifications for the future redesign of the operational computer program have been obtained. A start has been made on data processing for forecasting heavy precipitation.

SUPPORTED BY U.S. Dept. of Commerce, National Weather Service, Systems Development Office

***5.0022, AUTOMATION OF FIELD OPERATIONS AND* SERVICES - PRODUCT DEVELOPMENT AND EXPERIMENTATION**

R.L. Hovey, U.S. Dept. of Commerce, National Oceanic & Atmospheric Admin., National Weather Service, Systems Development Office, *8060 13th St., Silver Spring, Maryland* 20910 *(8C27033)*

OBJECTIVE: To develop new or improved products, and through experimentation, derive methods for using these products to enhance the operational capability of NWS field offices.

APPROACH: Analyze the requirements for new and improved products and translate these requirements into AFOS-compatible software. Verify the software capability and through experimentation optimize this capability with the human interface.

PROGRESS: 1. Completed Surface Aviation Observation (SAO) decoder development and test. 2. First draft of Aviation *Route Forecast (ARF) test and evaluation plan completed. 3.* Contract awarded to Penn State University for development of 'forecaster aids for mesoscale guidance'. 4. Extensive functional *debugging tests conducted on the AFOS minimum capabilities* software package.

SUPPORTED BY U.S. Dept. of Commerce, National Weather Service, Development Div.

5.0023, MATH AND PHYSICS STUDIES

N. Grossbard, Boston College, Chestnut Hill Campus, Graduate *School, 140 Commonwealth, Chestnut Hill, Massachusetts* 02167 (DF247420; F19628-76-C-0147)

Research - upper atmospheric studies and rocket attitude *determination. How research contributes - studies of high resolution* solar data. Emission intensity studies in the earth's ionosphere and determination of dynamical motion of rockets.

Using numerical analysis, Fourier methods and integral equation techniques, mathematical models will be developed to test and improve the performance of space vehicles.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0024, NUMERICAL SIMULATION OF THE FINAL *STAGES OF TERRESTRIAL PLANET FORMATION*

J.S. Lewis, Massachusetts Inst. of Technology, School of Science, Dept. of Earth & Planetary Sciences, 77 *Massachusetts Ave., Cambridge, Massachusetts 02139* (EAR79-04169)

This project involves the development of theoretical models simulating the dynamic processes of planetary accretion involved during the formation of the solar system. Specific objectives of the project include: 1. Further development of numerical simulations of the final stages of terrestrial planet accretion to include more realistic initial mass distributions for the protoplanets and a simple model providing for disruptive collisions. 2. Further study of the orbits resulting in collisions between protoplanets to gain a more accurate understanding of the 'gravitational collision cross-section' of an accreting body than

is afforded by the two-body gravitational model. These studies will provide a basis for generalizing the simulations to include three-dimensional protoplanetary systems. 3. An investigation of the possibility of satellite capture as a consequence of repeated close encounters between the same pair of protoplanets.

These studies, along with parallel studies of the chemistry of solar material, are essential to an understanding of the processes at work in the formation of the solar system.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Earth Sciences

5.0025, HIGH ENERGY PLASMA ANALYSIS
B.F. Sellers, Panametrics Inc., *221 Crescent St., Waltham, Massachusetts* 02154 (DF249030; F19628-77-C-0137)

AF function - communications and reconnaissance. Deficiency -anomalous behavior of high altitude satellites. Research - calibrate, integrate and evaluate instrumentation to measure electron and proton fluxes in .05 - 500 keV energy range. How research contributes - this analysis will be of an instrument used in the SCATHA satellite as one of a number of sensors intended to define the particle and field environment at synchronous orbit and its effect on satellite performance. It involves the integration, calibration and testing of SCATHA satellite instruments, the in-orbit operation, and the evaluation and analysis of research data from this instrument. These data will further the understanding of the synchronous orbit plasma and the causes of spacecraft charging.

This contract will provide for the integration, calibration, evaluation, and data analysis of a high time resolution particle spectrometer aboard the SCATHA satellite. By defining on a rapid time basis the influx of energetic plasma to the SCATHA satellite, the build up of potential and charge aboard a synchronous orbit satellite will be better understood. The in-orbit operation of the experiment, in coordination with other SCATHA instruments, will relate cause and effect in spacecraft charging and help to provide design criteria so that future space systems will be resistant to spacecraft charging.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Geophysics Lab.

5.0026, LINE SHAPE AND FREQUENCIES
R. Davies, University of Lowell, Research Foundation, Center for Atmospheric Research, *Lowell, Massachusetts* 01854 (DF248500; F19628-77-C-0053)

Af function - surveillance programs, infrared backgrounds, target detection. Deficiency - the lack of knowledge of the line shapes and widths of atmospheric absorption lines is a serious problem in evaluating laser propagation through the atmosphere and other atmospheric problems. Information is also required on the absorption due to weak lines in the window regions of the atmospheric spectrum. Research - the objective of this research is to develop the theory of line shapes with emphasis on the far wings. This will provide information on the continuum absorption as function of Broadener pressure and molecular temperature. Computational schemes will be developed to calculate transition frequencies and intensities of weak atmospheric lines. How research contributes - the results of this research will provide a theoretical and computational basis for the determination of low and high resolution absorption observations in the atmosphere.

Using many-body treatments develop the theory of collisional broadened line shape, with emphasis on the far wings.

SUPPORTED BY U.S. Dept. of Defense, Air Force,
Geophysics Lab.

5.0027, THREE-DIMENSIONAL SLOPE AND VALLEY WIND SYSTEMS 12641-GS
W. Tang, University of Lowell, School of Pure & Applied Science, Dept. of Meteorology, *Lowell, Massachusetts* 01854 (DA0T5572; DAAG29-78-G-0012)

To model variations in wind circulations in a three-dimensional slope and valley-plain terrain situation, coupling the interactions between the upper air flow and the thermally induced lower level winds which vary diurnally. Relevance: Three-dimensional modeling of air motion over complex terrain has relevance to transport and diffusion of obnoxious materials- for identifying optimal conditions for laying smoke screens- for wind effects on artillery accuracy, low level helicopter operations, and other Army activities in mountainous terrain. The study should contribute to the development of operational terrain effect models for the Army's automatic meteorological system.

The research involves the development of the governing differential equations for air motion and temperature above mountain-valley terrain. The equations will be solved numerically and the results checked with analytical solutions and with real data.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel
Development & Readiness Command,
Army Research Office

5.0028, DEFORMATION, TEMPERATURE, AND FABRIC STUDIES ALONG A FLOW LINE, BARNES ICE CAP, BAFFIN ISLAND, CANADA
R.L. Hooke, University of Minnesota, Minneapolis Campus, School of Earth Sciences, Dept. of Geology & Geophysics, *105 Morrill Hall, Minneapolis, Minnesota 55455* (EAR77-21098 A02)

This project involves a continuation of studies on the flow mechanisms and temperature distribution along a vertical section extending from the divide to the margin of the Barnes Ice Cap, Baffin Island, Canada. Temperatures, horizontal velocities, and vertical strain rates will be measured in six holes, and cores taken for ice fabric studies. Four of the holes have been completed in the past three years and another started. The two remaining holes will be completed during the next year, and all holes resurveyed the following year. Data collected will be used to study anisotropy in the ice and its effect on the flow law and to study the feedback between the increase in flow rate caused by increase in temperature and the increase in temperature caused by increase in flow rate. The ultimate objective is to develop and test a computer model of the flow field and temperature distribution in the ice cap.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Earth Sciences

5.0029, THE FORMATION, MAINTENANCE, AND CLIMATIC EFFECTS OF WEST COAST SEA STRATUS
J.W. Telford, University of Nevada, System Office, Desert Research Inst., Atmospheric Sciences Center, *Reno, Nevada* 89507 (ATM77-16321)

The objective of this research is to use an instrumented aircraft to gather cloud microphysical properties and radiative fluxes of stratus clouds so as to examine in detail the latest models and thinking related to the formation and persistence of ocean stratus and fog.

Special emphasis will be made on the role of radiation and cloud top mixing processes on the development and persistence of these clouds.

During the initial stages of this program, the efforts will be primarily to install, calibrate, and test the performance of cloud physics and radiation instruments aboard the DRI research aircraft.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

5.0030, USE OF AIRCRAFT SPECTRORADIOMETRY TO DETERMINE WATER QUALITY
H.L. McKim, U.S. Dept. of Defense, Army, Corps of Engineers, Cold Regions Research & Engineering Lab., *P.O. Box 282, Hanover, New Hampshire* 03755 (31583)

OBJECTIVE: To quantitatively assess water quality parameters in fresh and salt water regimes utilizing aircraft spectroradiometer data and to conduct laboratory tests to determine spectral bands of interest for quantitative and qualitative mea-

surement of water quality data, to meet Corps of Engineers requirements and to demonstrate usefulness of data in field studies.

APPROACH: A prototype 500-channel aircraft spectroradiometer instrument with a 10 angstrom spectral resolution is being used in the study to assess water quality parameters in fresh and salt water systems. The instrument provides a digital tape readout for 500 channels ranging from the visible (0.42 microns) to the near infrared wavelengths (1.0 microns) for a nominal 60 x 60 ft. area. Laboratory testing to determine spectral bands of interest will continue with the airborne spectroradiometer instrument. The results will be compared to field tests accomplished in FY79. Aircraft spectroradiometer flights over selected test site areas will be accomplished in conjunction with ground truth data acquisition. The ground truth will be obtained by District personnel. Analysis of the high resolution multispectral data will be used to qualitatively and quantitatively assess water quality parameters, especially turbidity (organic and inorganic), based on correlation to field measurements.

In addition, the GISS theoretical model will be run with data taken from FY78-80. Spectral response curves will be generated based on varying the size, optical properties and density of particulate matter. Results from the FY78-80 aircraft flight analyses and laboratory experiments will be compared to conventional ground techniques. A procedure to assess water quality will be developed for use by Corps of Engineers Division/ District personnel.

SUPPORTED BY U.S. Dept. of Defense, Corps of Engineers, Cold Regions Research & Engineering Lab.

5.0031, TECTONIC EVOLUTION OF THE SOUTHERN CENTRAL PACIFIC BASIN

R.L. Larson, Columbia University, Lamont Doherty Geological Observatory, *Palisades, New York* 10964 (OCE79-18793)

The Southern Central Pacific Basin is a portion of the Pacific plate whose plate tectonic history is as yet only partly understood. The crust here is probably Cretaceous, with an apparently complex history of sea-floor spreading, perhaps involving one or more ridge crest jumps and changes in spreading direction. Three models for the evolution of this region have been proposed, leading to quite different predictions concerning the structural and magnetic anomaly fabrics of parts of the region.

This study is a 31-day shipboard program of geophysical exploration in the Southern Central Basin. It will determine whether correlatable magnetic anomalies are present in the Samoa Basin and Tokelau Basin. It will also investigate the intersection of the Nova-Canton Trough with the Phoenix anomalies to test models for the origin of the Nova-Canton Trough. These studies will permit definitive tests of published hypotheses and the subsequent development of a more accurate model for the origin of the Southern Central Basin.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Ocean Sciences

5.0032, A STUDY OF PARTICLE SIZE SORTING IN MARTIAN WIND STREAKS

P. Thomas, Cornell University, Ithaca Campus, School of Arts & Sciences, Dept. of Geological Sciences, *Ithaca, New York* 14850 (NAGW 111)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

5.0033, DEVELOPMENT OF A MODEL FOR ESTIMATING THE EXTENT OF RIVER FLOODING WITH SATELLITE AND IN SITU DATA

W.R. Philipson, Cornell University, Ithaca Campus, School of Civil & Environmental Engineering, Dept. of Environmental Engineering, *Ithaca, New York* 14850 (A-089-NY)

The proposed research will attempt to develop an empirical model which uses in situ measurements of river discharge for operationally estimating the extent of flooding in New York's Black River Basin. Through various manual and computer approaches, flood boundary information would be derived from a number of selected LANDSAT satellite scenes, depicting a range of flood conditions. This information would then be related to the corresponding river discharge measurements.

The development of a reliable predictive model will allow real-time estimation of the extent of flooding over the entire basin as well as at specific locations. This information, in turn, would be used for estimating flood losses and planning flood control.

SUPPORTED BY U.S. Dept. of the Interior, Office of Water Research & Technology

5.0034, AERONOMICAL AND METEOROLOGICAL RESEARCH AT THE JICAMARCA RADIO OBSERVATORY

D.T. Farley, Cornell University, Ithaca Campus, School of Electrical Engineering, *Ithaca, New York* 14850 (ATM80-07971)

This grant funds aeronomical and meteorological research to be done at the Jicamarca Radio Observatory, near Lima, Peru, by the resident staff members of the Geophysical Institute of Peru together with US scientists. Research will be in four main areas: 1. Dynamics of the Neutral Atmosphere, including measurement and analysis of winds, waves, and turbulence in the troposphere, stratosphere, mesosphere, and E region. The system has unique capabilities for these studies. 2. Structure and dynamics of the equatorial F region. Observations will be compared with theoretical models of the equatorial F region and with models of the E and F region dynamos and equatorial-auroral zone electric field coupling. 3. Equatorial F region irregularities (Spread F). Emphasis will be put on the explanation of the physical mechanisms causing the several types of Spread F that have been identified by experiments at Jicamarca. Comparison with simultaneous satellite and rocket observations will play an important role. 4. Equatorial Electrojet Irregularities (Equatorial Sporadic E). Emphasis will be on understanding the plasma processes involved and the geographical asymmetries, which perhaps are coastal effects or are due to the Andes Mountain range.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

5.0035, MANAGEMENT AND IN-HOUSE RESEARCH ON REGIONAL VISIBILITY AND FINE PARTICULATE TRANSPORT AND TRANSFORMATION

W. Wilson, U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab., Regional Field Studies Office, *Research Triangle Park, North Carolina* 27711 (GA05 -0001)

OBJECTIVE: Determine power plant and urban plume dispersion, transformation, and the composition and size distribution of primary and secondary aerosols for assessing source contributions to visibility-reducing aerosol and inhalable particulate on a regional scale. Provide management and monitoring of extramural research program.

APPROACH: Field studies measure selected air quality and meteorological parameters. Historical weather data are analyzed for episodic occurrences and synoptic relationship.

SUPPORTED BY U.S. Environmental Protection Agency, Office of Research & Development, Environmental Sciences Research Lab.

5.0036, DEVELOPMENT OF GEOPHYSICAL TECHNIQUES FOR INSTALLATION RESTORATION (TMP185)

R.L. Costello, DAppolonia Consulting Engineers Inc., *10 Duff Rd., Pittsburgh, Pennsylvania* 15235 (DA0G2821; DAAK11-80-C-0029)

The objective of this contract is to develop geophysical remote sensing and well-logging techniques that can be advantageously applied to shallow geologic and aquifer analysis. The most feasible techniques identified will be tested at one installation presently being studied by the US Army Toxic and Hazardous Materials Agency (USATHAMA).

The contractor shall identify and briefly describe geophysical remote sensing and well logging techniques that will achieve but not be limited to the following: definition of aquifer proper-

ties, definition of geologic structures, definition of stratigraphy. Description will include procedures, equipment, method evaluation, the geologic and groundwater conditions where the method is applicable, and a cost range for application and evaluation of a fixed area or bore hole depth. The contractor shall write a plan to test the recommended techniques at one Army installation where installation restoration work is ongoing or will be accomplished in the near future. The contractor shall perform the tests and evaluate the test data and derive conclusions based on the results. Recommendations for future use of various geophysical techniques shall be made by the contractor.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Toxic & Hazardous Materials Agency

5.0037, CLIMATE RESOURCES OF THE TEXAS COASTAL ZONE

K.H. Jehn, University of Texas, Austin Campus, School of Engineering, Dept. of Civil Engineering, *200 W. 21st, Austin, Texas* 78712

DESCRIPTION: The atlas of water balance parameters mentioned in ENGINEERING RESEARCH 1978 has been completed and published. The data base was the 30-year record (1941-1970) of temperature and precipitation for 48 Texas coastal zone stations. The water balance parameters include potential and actual evapotranspiration and moisture deficits and surpluses for these stations, along with the geographical distributions of these and related water resource quantities.

The next step is to utilize this information in devising an inventory of climate resources of the Texas coastal zone suitable for inclusion in an atlas of environmental resources of this region. As noted last year, climatological data are not usually presented in this way and, therefore, are anomalous in such environmental atlases. Support is being sought for this continuing effort.

SUPPORTED BY University of Texas

5.0038, NAVY ENVIRONMENT - GEOPHYSICAL DATA ANALYSIS

S.A. Vincent, Phoenix Corp., *1700 Old Meadow Rd., McLean, Virginia* 22101 (DN975375; N00014-79-C-0409)

Satellite altimetry and aeromagnetic data will be analysed for studies of ocean gravity anomalies, ocean tides, and geomagnetic field fluctuations. Application of gravity gradiometry to geophysical research and Navy operations will be identified.

GEOS-3 and SEASAT satellite altimetry data will be analysed for ocean tidal components in the northeast pacific. A detailed background review will be conducted on the relevant physical aspects of the various sources of temporal geomagnetic field variations and their quantitative indicators. The state-of-the-art in moving platform gravity gradiometer instruments and measurements will be determined. Known geophysical features of interest will be modeled and the gradient signatures of the features will be studied for their impact on research and operations.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

5.0039, WAVE DYNAMICS AND TRANSPORT IN THE STRATOSPHERE

J.R. Holton, University of Washington, School of Arts & Sciences, Dept. of Atmospheric Science, *Seattle, Washington* 98105 (NAG 2-66)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

5.0040, BALLOON-BORNE MEASUREMENTS OF STRATOSPHERIC CONDENSATION NUCLEI

J.M. Rosen, University of Wyoming, School of Arts & Sciences, Dept. of Physics, *P.O. Box 3435, University Station, Laramie, Wyoming* 82070 (NAG 2-65)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

5.0041, ATMOSPHERIC ASPECTS OF EMPLOYMENT OF CO2 LASER

P. Browne, University of Manchester, University of Manchester Inst. of Science & Technology, *Sackville St. 1 Lancs, Manchester, England, United Kingdom* (DA0D9330; DAERO 78 G0126)

To determine the effects of atmospheric clouds, fogs, and mists on the propagation of coherent electromagnetic radiation with a wavelength of 10.4 micrometer, with special attention to linear attenuation and backscattering, non-linear attenuation and backscatter, and beam quality under both linear and non-linear propagation conditions for clouds produced in the laboratory by adiabatic expansion.

Greatly-improved versions of a high-energy pulsed CO2 laser, and a low-power continuous-emission CO2 laser will be developed, so that they can be used both in the laboratory and the field. Laboratory experiments will be based on measuring transmission and scattering characteristics of the beams while propagating through water aerosol clouds generated by adiabatic expansion of saturated air in a chamber under controlled conditions. Field experiments will be conducted in natural water aerosols at Great Dun Fell. Close coordination will be maintained with the atmospheric sciencies laboratory and with other Army laboratories.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Research & Standardization Group

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, DEVELOPMENT OF PSYCHO-PHYSIOLOGICAL MEASURES PREDICTIVE OF AVIATION PERFORMANCE

R.E. Doll, U.S. Dept. of Defense, Navy, Naval Aerospace Medical Research Lab., Aerospace Psychology Dept., *Pensacola, Florida* 32512 (DN977562)

Objective: The object of this work unit is the measurement and evaluation of psycho-physiological human ability measures that have the potential to significantly predict aviator performance in replacement training squadrons (RTS) and fleet squadrons. Due to the great length of time required to determine the relationship to psycho-physiological human ability measures to aviator performance in RTS and fleet operational environments, preliminary investigations will be concerned with human performance in an undergraduate flying environment. Early criteria to be used to evaluate the utility of psycho-physiological human ability measures will include (1) primary flight performance, (2) intermediate flight performance (STRIKE, MARITIME and HELO), (3) advance flight performance (STRIKE, MARITIME, and HELO), and successful undergraduate performance. Ultimately, RTS and fleet squadron standardized summary performance grades and certain fleet performance indices will be related to the psycho-physiological human ability measures. Since the present BUMED United States Navy and Marine Corps aviation selection tests are primarily perceptual and cognitive pencil-and-paper test instruments, it is anticipated that the development of psycho-physiological human ability measurement instruments will provide for an improved capability to select aviators who will have a greater flying fitness capability in operation environments. Additionally, the psycho-physiological measures have the potential for improved primary, secondary selection, and pipeline assignment, thereby affecting important naval aviation cost savings. In addition, it is anticipated that performance measurements will be accumulated for psycho-physiological measures on the basis of age. With time, such measurements may be used to evaluate skill maintenance levels, and provide a basis other than age for assigning service group flying categories.

The research effort will obtain psycho-physiological human ability measures on a substantial Navy population. The first psycho-physiological measures to be investigated is multilimb coordination ability - the ability to quickly and accurately perform coordination movement of body muscle systems as a result of the perceptual and kinesthetic recognition of velocity and

speed movements in a dynamic three-dimensional environment. (Text Abridged).

SUPPORTED BY U.S. Dept. of Defense, Naval Medical Research & Development Command, National Naval Medical Center

6.0002, INVESTIGATION OF RELATIONSHIPS BETWEEN CREW RESTRAINT DESIGN CRITERIA AND IMPACT INJURIES

C.F. Acevedo, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF322360)

USAF accident investigations reveal that major injuries and fatalities may be related to the ineffectiveness of the personnel restraint systems under emergency escape or aircraft crash conditions. For example, operational statistics and aeromedical analysis have shown that the high spinal fracture rate (42 percent) occurring during use of the F-111 crew escape module is probably related to the geometry of the restraint system and ballistic inertia reel. Although design criteria are available they are often disregarded since their relationships to crew injuries are seldom quantified. The objective of this research effort is to determine the injury pathology associated with a specific impact protection system's design criteria. These criteria pertain to restraint system geometry, restraint tie-down points, webbing materials' properties, load distribution and integral impact attenuation.

The injury potential associated with specific restraint systems will be experimentally evaluated using a subhuman primate. A baseline for comparative evaluation of protection systems will be established by conducting impact tests using the standard USAF lap belt and shoulder harness geometry published in current design specification handbooks. Impact injury pathology will be assessed using the AMA abbreviated injury severity index. Other restraint systems that are operational or in the conceptual design phase will be similarly tested to identify unique injury modes and to compare the severity of the observed injuries with those of the baseline protection configuration. Data collected under this workunit will also be used to provide methods for predicting impact injury severity using mathematical models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0003, CONCEPTUAL DESIGN AND MODIFICATION OF HUMAN IMPACT RESEARCH FACILITIES

J.A. Brown, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF321460)

The success of research to define human exposure limits to emergency escape and aircraft crash environments and the development of design and evaluation criteria for personnel protective equipment in these environments is dependent upon the availability of adequate impact test facilities and equipment. The facilities must be capable of producing and measuring the complex acceleration-time histories that are experienced in USAF operations. Furthermore, they must be designed to meet the unique safety requirements associated with the use of volunteer subjects. The objective of this effort is to plan, design and/or modify impact test facilities and test fixtures required by experimental designs to meet USAF technology needs and operational safety requirements.

The capabilities of existing facilities and test equipment are assessed by test and analysis. Requirements for future research programs are studied to determine if these requirements can be met by existing equipment or by modification of this equipment. If new designs are required to meet the requirements, the design is developed through the conceptual phase and procurement specifications and plans are prepared and implemented. Operational performance capabilities and reliability of new and existing facilities are documented for review by laboratory engineering safety and human use committees. New instrumentation and data processing techniques are continuously investigated to improve measures of biodynamic responses and overall measurement accuracy.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0004, MEASUREMENT, PREDICTION AND EVALUATION OF BIOENVIRONMENTAL NOISE IN SUPPORT OF AF SYSTEMS/OPERATIONS

N.A. Farinacci, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF321430)

The goal is to provide technical support required by system program offices, MAJCOMS, airbases, AF labs, and others on specific environmental noise problems that would otherwise be outside the scope of AMRL's R&D program. This support provides 200 to 300 customers per year with the data, procedures, software, and guidance needed to define and evaluate crew and community noise problems caused by specific existing or planned Air Force operations. The range of problems include-AICUZ, noise exposure/levels for environmental impact statements, facility siting, real estate decisions, monitoring of airbase noise, sound propagation, runup noise suppressors, identifying hazardous noise areas/operations, and computational/analytical methods.

The approach is to measure, predict and evaluate the customer's specific noise problem by applying the instrumentation, measurement methods, noisebank, OMEGA software, predictive methods and other tools developed by AMRL. Travel/per diem costs will generally be paid by the customer. Results will usually be documented in the form of letter reports or memoranda.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0005, ACUTE FISH BIOASSAY

J. Fisher, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF320510)

To determine the water pollution potential of aircraft fuels and lubricants, missile propellants and their exhaust products, and other AF materials that if in sufficient quantity could result in significant detrimental effects on the environment. Transient physiological changes in organisms and toxic effects up to fish kills can serve as indices of potential pollution of the aquatic environment. The results of these studies will serve as a data base upon which environmental impact statements and assessments can be made as they apply to weapon systems using these chemicals especially where they may possibly enter an aquatic environment. The acute fish bioassay portion of previous workunit (AMRL-6302-04-11) was transferred to this workunit.

The approach to this effort utilizes experimental concepts developed in water pollution technology and fisheries biology. The applied conditions of these operational AF compounds and the types of test organisms to be utilized determine the methodology for experimentation. Propellant bioassays accomplished with guppies will be repeated using the fathead minnow currently and other fish species subsequently. The acute toxicity of hydrazine, UDMH, Aerozine-50 and MMH, espectively, will be determined. Following the determination of acute toxic levels of these important compounds, the efficacy of various chemicals will be evaluated relative to reversing or reducing the toxicity to fish life.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0006, OPTICAL PROPERTIES OF WINDSCREENS

L.V. Genco, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF321120)

To relate the optical characteristics of aircraft forward transparencies to specific aspects of visual performance. F-111 and new geometric configurations will be evaluated. Optical deficiences include distortion, binocular disparity, multiple imaging birefringence coloration and transmission loss. The ultimate goal of this workunit will be the development of a set of visual perception measures to be used in acceptance testing of aircraft windscreens. These measures will influence the selection of optical tests. Data collected under this workunit using these measures will form the basis for setting of optical specifications.

Through ground-based laboratory experimentation, this research program will be directed toward the determination of performance limiting changes in visual perception produced by

optical deficiencies in aircraft windscreens. Results will be interpreted with respect to measures of windscreen optical quality. Examination of the effects of optical distortion requires tests of- (a) visual acuity, both static and dynamic, (b) motion perception in terms of movement thresholds, velocity estimations, and two-dimensional eye-tracking accuracy, (c) distance perception with respect to static and dynamic targets, and (d) depth perception, both near and far field. The distracting influence of multiple imaging will be investigated by monitoring three-dimensional eye-tracking accuracy, while birefringence coloration effects will be determined by measuring the changes in accommodation that are produced. For all testing situations, short-term viewing influences will be differentiated from long-term viewing influences. Visual quality inspection process will be categorized, psychometrically quantified and related to optical, pilot and laboratory performance measures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0007, COMPARATIVE RESPONSE OF MAN AND ANIMALS EXPOSED TO IMPACT

L.E. Kazarian, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF322420)

Spinal injuries due to abrupt Gz impact forces occur frequently in the operational Air Force environment. Injury patterns experienced are diversified, and range from simple vertebral body fracture to vertebral subluxation with spinal cord and nerve root involvement. The objective of this investigation is to provide an in-depth biomechanical and clinical analysis of operational spinal injury patterns for purposes of supporting injury prediction model development, which will in turn be used as system design aids, and further to understand the microscopic and macroscopic failure mechanisms which are involved in the kinetic and kinematic events resulting in injury.

Interspecies scaling relationships will be formulated between the squirrel monkey, rhesus monkey, baboon, chimpanzee and man. The musculoskeletal system will be modeled based upon geometry and material property data. Experimental data will be collected on isolated vertebral bodies, vertebral units and the points of rib articulation. Data will be collected on the ranges of torso motion. These data will be integrated into a generalized mathematical model of the torso. Experimental data will be collected on injury modes and correlated to specific support and restraint goemetries for model injury prediction validation. Subsequent studies will be made applying the model to the predictive analysis of injury for various restraint configurations and modes of human exposure in potential and existent Air Force systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0008, CONTROL-DISPLAY INTEGRATION AND EVALUATION

J.L. Porterfield, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF321060)

The purpose of this workunit is to develop new control, display and feedback hardware and software concepts that use hand, head, eye, voice, and other human response modes as controllers, along with visual and voice displays, to improve the piloting, weapon delivery, and sensor control of manned and unmanned aircraft.

Operator performance data on laboratory simulation, breadboard, and prototype equipment designed to make optimal use of natural perceptual and response capabilities will be analyzed. Digital computers will be used to process environmentally sensed information, modify the human's response signals, and process feedback information about the controlled element. The following control-display concept studies are planned: (1) use of a helmet mounted sight, a simulated fire control computer, and simultaneous helmet mounted display computer graphics imagery in a simulated experimental fire control system; (2) use of synthetic voice display; (4) head tracking of a 6 degree of freedom target; (5) multiresolution, eye-aimed television; and (6) simultaneous tracking on dual peripheral displays. The products of these studies will be new systems concepts and designs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0009, UPDATE AIRCRAFT NOISEFILES INTEGRATING ADDITIONAL SOURCES PLUS ESA AND DEFLECTOR STUDY RESULTS

J.D. Speakman, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF325770)

The AMRL noisefiles contain the aircraft flight and ground runup basic noise data used by the noisemap environmental noise exposure predictive procedure. It is essential that these noisefiles be continuously updated to include new aircraft as they are developed, and that they be modified as required, consistent with improvements in the state-of-the-art, to insure the continuing technical credibility of the environmental noise impact assessments made Air Force wide using these data.

Noise measuring instrumentation, test protocols, and data reduction techniques previously developed by AMRL will be used to insure continuity with prior data acquired and analyzed on over 40 aircraft. Modifications to the noisefiles will be done systematically to reflect proven results from WU 72310704 on excess sound attenuation and revisions in accepted national or international standards on noise propagation and prediction methodologies.

SUPPORTED BY U.S. Dept. of Defense, Aerospace Medical Research Lab., Biodynamics & Bionics Div.

6.0010, VISUALLY ACQUIRED REFLECTIVE GLIDE SLOPE INDICATOR, LDF 79-10

H.L. Task, U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab., *Wright Patterson A.F.B., Dayton, Ohio* 45433 (DF325540)

The purpose of this effort is to design, build and test a reflective glide slope indicator that will use the aircraft landing lights as the light source. The VARGSI will provide a color coded reflection of the aircraft landing lights to visually cue the pilot to the correct glide slope angle.

There are several ways in which an optical system can be devised that would be capable of producing the desired effect. Each method has certain advantages and disadvantages in terms of intensity of the reflected light, ease of color coding, complexity and expense. Each design will be evaluated on paper. Working models of one or more designs will be produced and tested under lab conditions. The most promising design(s) will then be field tested to determine visibility and angle sensitivity characteristics under actual outdoor conditions. If the field tests are favorable, it is possible that the device would undergo flight testing. Tentative arrangements have been made with the Army Aeromedical Research Labs at Fort Rucker, AL to test the final device for helicopter landings. This effort is supported by O&M contract documented under work unit 71840006.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0011, CRITERIA DETERMINATION OF THE ADVERSE EFFECTS OF LIGHT ADAPTATION IN THE NAVAL AVIATOR

G.T. Chisum, U.S. Dept. of Defense, Navy, Naval Air Development Center, Aircraft & Crew Systems Tech Directorate, *Warminster, Pennsylvania* 18974 (DN133013)

To develop the requirements for protection of the human visual system against adverse light adaptation situations which occur in combat conditions and in the use of devices such as novel eye position sensing systems and low light level viewing and display devices which are both operational and are being designed for use by naval aviators. The requirement for work in this area is established by naval research codes PA-10, lS4 and lS5 of the FY 1974 Naval Aviation Biomedicine/Human Effectiveness Technical Workshop Report.

Electroretinograms will be recorded from human observers following exposure to adapting light stimuli. Conditions to be

varied are the level of light adaptation, the intensity of the adapting stimulus, and the duration and chromatic composition of the adapting stimulus. Of special interest will be the effects of eye position sensing pulses (including laser pulses) such as are used with some head-coupled weapon control and guidance systems and chromatic adaptation of the type encountered in the use of low light level viewing and display systems.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Medical Research Inst.

6.0012, EFFECTS OF PURE TONES IN INTELLIGIBILITY AND PILOT WORKLOAD

M.D. Arnoult, Texas Christian University, AddRan College of Arts & Sciences, Dept. of Psychology, *2800 S. University Dr., Fort Worth, Texas* 76129 (NAG 2-69)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Ames Research Center

6.0013, OPERATIONAL LIMITS TO REPEATED EXPOSURE OF HIGH PLUS Gz ACM

J.W. Burns, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF324130)

To investigate the physiologic response of experimental animals to operational levels of sustained and repeated plus Gz similar to air force pilot exposures in high performance aircraft. Of particular interest is the distribution of blood flow to various organ systems as well as the dynamics of venous return to the heart during acceleration and the influence of the g-suit on venous return.

Experimental animals will be instrumented for the measurement of cardiovascular function and regional blood flow before, during, and after operational acceleration exposures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0014, AN INVESTIGATION OF THE BEHAVIORAL EFFECTS OF TAB

D.N. Farrer, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF324100)

The objective of this workunit is to provide the basis for a cooperative study between the Biomedical Laboratory, Chemical Systems Laboratory, U.S. Army, and the USAF School of Aerospace Medicine, Aerospace Medical Division, for the assessment of the decrements of performance that may occur in primates as a result of administering prophylactic and therapeutic drugs which may prove efficacious against toxic chemical agents. These drug studies are in support of medical chemical defense and flying performance decrement and will not involve the testing of chemical agents. The initial animal model will be the macaque and the drugs to be investigated initially will be those that constitute the current standard antidote, TMB4, atropine, benactyzine (TAB), or those requested by the USAF SG. Additional animal models and drugs may be selected as appropriate.

Macaques trained to perform useful work (maintain level position on a simple flight simulator, reaction time tasks, oscilloscope displayed tracking tasks) will be utilized to develop dose response decrement curves for antidotes and/or prophylactics which have been determined efficacious in the treatment of organophosphate exposures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0015, EAR LOBE CREASE - RELATIONSHIP TO CORONARY ARTERY DISEASE IN HUMANS

H.H. Hanna, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF321910)

To determine the incidence of significant ear lobe creases in various age groups of selected apparently asymptomatic individuals and to verify the reported correlation of ear lobe creases with coronary artery disease.

Patients referred to the aeromedical consultation service will have a color photograph made of each ear lobe to document the presence or absence of skin creases. In those individuals who later have cardiac catheterization with coronary angiography, correlation of ear lobe creases with coronary artery disease will be determined. Those individuals who do not have cardiac catheterization will comprise the control group for incidence of ear lobe creases. This work was formerly documented under 7755-08-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0016, WINDSCREEN EVALUATION- F-111 AND GENERIC

W.F. Provines, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF321960)

High performance aircraft windshields designed to withstand bird impact have evolved into thick, curved, laminated new materials compositioned transparencies of large dimensions. This effort will provide optical measurements and visual performance capabilities of trained observers through a variety of segments and full scale windshields characteristic of USAF inventory and emerging aircraft. Test results will provide scientifically based tolerance values for windshield specification writers and guidance to windshield manufacturers on realistic quality control measures.

An optical laboratory has been established. The facilities and equipment provide capability for accurate determinations of transmission, haze, deviation, distortion and multiple image production for any aircraft windshield provided for study. Visual performance testing in the Physiological Optics Laboratory is being conducted. utilizing several F-111 windshields of known optical defects, the inducted phoria effects of vertical prism disparity are being objectively and subjectively determined. A follow-on study is planned to ascertain the induced spatial warping effects (magnification) of those windshields. Coordination with AMRL personnel engaged in related optical-visual performance studies will be maintained. Efforts previously documented under workunits 7755-09-01 and 7755-09-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0017, GLAUCOMA

T.J. Tredici, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF323020)

Glaucoma has long been recognized as an important cause of ophthalmologic morbidity and removal from flying status in USAF aircrew personnel. A concerted effort is made at base level to identify affected aircrew personnel early, based on elevated intraocular pressure. This is most practically performed by using the Schiotz tonometer. The use of this instrument is taught to all flight surgeons during their course of instruction at USAFSAM. Further, the use of tonometer as part of the base level follow-up program is the most important part of the USAF policy on glaucoma. The objective of this workunit is to evaluate criteria for diagnosis, to delineate factors or characteristics which identify the point in the disease process when therapy should be instituted, to evaluate therapeutic modalities for both efficacy of treatment in absence of visual side effects which would contraindicate the performance of further flying duties, and where possible, to identify factors which causally relate progression of the disease.

The approach will involve careful and detailed ophthalmologic evaluation of each individual patient, with both follow-up interval and decision to commence therapy to be determined on an individual basis. the extensive and changing knowledge in literature in this field, both military and civilian sources, will be utilized as well as the accumulated expertise of the ophthalmology branch, clinical sciences division, in follow-up and treatment of this disorder in aircrew personnel. The study will also include those patients with a diagnosis of glaucoma who are on therapy with epinephrine drops which is recognized as efficacious and accepted by the Surgeon General for chronic use

while retaining flying status (AFR 160-12). Work under this unit was formerly conducted under 7755-09-05 and 7755-09-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0018, STEREO ACUITY
T.J. Tredici, U.S. Dept. of Defense, Air Force, School of Aerospace Medicine, *Brooks Air Force Base, San Antonio, Texas* 78235 (DF323040)

The traditional decision point in ophthalmologic considerations regarding flying status has been differentiating those individuals with a phoria from those with a manifest deviation or tropia. Those with tropias (crossed eye) have not been qualified for flying status because of defective stereoscopic vision and their almost universal failure of the depth perception tests. A distinct category of patients between these two extremes has not been identified in the patient population of the aeromedical consulation service. These individuals do indeed have a tropia but one of extremely small degree. These individuals do retain some degree of stereoscopic vision, and many can pass one of the USAF depth perception tests. The term developed for this type of disorder is 'microtropia.' Following battery motility testing procedures, a number of USAF flying personnel have been recommended for waiver for continued flying status. Since this is a totally new entity in the ophthalmologic field, the true nature of the process, its causes and ultimate prognosis -- i.e., progression to greater visual disability--are not yet clearly delineated. The objective of this workunit is to continue to follow such patients over time to provide the presently lacking new knowledge and to validate the established policy of continued flying for individuals with this condition. New stereoscopic testing equipment needs to be developed. Presently available testing devices are not sufficiently sensitive to carry out some of the tests desired.

Those USAF aircrew referred to the ophthalmology branch, clinical sciences division, who have failed the USAF stereoscopic depth perception test will be put through an extensive battery of diagnostic tests to determine the cause of their failure. If the etiology of their failure is microtropia, they will be followed under this unit for aeromedical assessment regarding stability or progression. As new knowledge regarding this entity is developed, it will be transmitted to the field for utilization in all Air Force medical facilities and further disseminated to civilian and military ophthalmological community through publication of scientific papers. An attempt will be made to develop new and more refined stereoscopic testing devices by contractual effort. Work was formerly conducted under work unit 77550905.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, TWO-DIMENSIONAL MESH ADJUSTMENT ALGORITHM
C.M. Ablow, S R I International, *333 Ravenswood Ave., Menlo Park, California* 94025 (DF048310; F49620-77-C-0114)

AF function - design of aerospace vehicles, study of nuclear weapons effects. Deficiency - the computation of functions with sharp variations requires small finite difference intervals for accuracy for certian regions while in other regions large intervals are needed for economy of computer time. Numerical techniques which eliminate or reduce the loss of accuracy due to mesh irregularity are needed. Objective -this research will investigate the use of a uniform mesh in a transformed coordinate system that expands the boundary layer in fluid flow problems. Extension of one dimensional techniques to 2D will be studied. How work contributes - techniques which may offer a reduction in storage in the computer with same accuracy may be obtained.

This effort will attempt to establish a transformation of coordinates that facilitates the finite difference solution of partial differential equations in two dimensions. Analytical efforts will be spent to define the most campylotropic coordinate system for the solution of the PDE's. A rearrangement of the two-dimensional equations into uniquely solvable form will be derived. Methods for the approximation of the derivatives by finite differences and solving the resulting algebraic system will be explored. Questions on the range of applicability of the methods developed will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0002, ALGORITHMS FOR EFFICIENT MATRIX COMPUTATION
J. De Pillis, University of California, Riverside Campus, Graduate School, Dept. of Mathematics, *Riverside, California* 92502 (DF041360; AFOSR-75-2858)

AF function - the study of the effects of nuclear detonation on aerospace vehicles, permanent structures and equipment. Deficiency - the numerical solution of the PDE's arising in these studies require large numbers of matrix multiplications which are very expensive on computer time. Objective - this research intends to develop fast matrix multiplication algorithms and techniques for the efficient solution of linear systems. How work contributes - this research may generate algorithms and techniques which can be implemented into effective computer codes to reduce substantially the cost of computation.

This effort intends to develop fast algorithms and techniques for (1) reducing the number of scalar multiplications required to multiply rectangular matrices together, (2) solving a system of linear equations. In this area if a sequence of values obtained iteratively by a classical two-part splitting like Gauss-Seidel or SOR technique diverges, this sequence can be converted under certain conditions into a convergent sequence. If the original sequence converges then, under certain conditions, such convergence can be accelerated. Cases in which the linear system is sparse or singular will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0003, STUDY OF RECEPTIVITY AND TRANSITION OF LAMINAR FLOWS IN A NATURAL DISTURBANCE ENVIRONMENT
C.K. Tam, State University System of Florida, Florida State University, School of Arts & Sciences, Dept. of Mathematics, *205 Wildwood Dr., Tallahassee, Florida* 32306 (CME78-05122 A01)

Receptivity problems in hydrodynamic stability deals with the excitation of unstable waves by free stream disturbances. The research is centered on the receptivity of boundary-layer and wake flows in a natural disturbance environment. At subsonic speeds the natural disturbance consists of randomly occurring sound waves and free stream turbulence which can be characterized only by certain ensemble or time averaged statistics. The spatial evolution of the excited unstable wave spectrum will be analyzed taking into account non-parallel and weakly nonlinear effects. An important aspect of this research is to clarify the role of unstable wave spectrum on transition. The results of this investigation will have direct impact on laminar flow control technology and wind tunnel measurements. This action provides additional support to this ongoing activity previously supported under NSF Grant No. CME 78-05122.

SUPPORTED BY U.S. National Science Foundation, Directorate for Engineering & Applied Science, Div. of Civil & Mechanical Engineering

7.0004, TRANSONIC WING-BODY CALCULATIONS
A. Jameson, New York University, Courant Inst. of Mathematical Sciences, *251 Mercer St., New York, New York* 10012 (DN775079; N00014-77-C-0032)

The development of accurate methods for the prediction of the transonic flow fields about complex aircraft and missile configurations is essential for their design and optimization. The proposed research will develop finite-difference techniques for

solving the complete potential equation for the transonic flow about three-dimensional configurations.

The development of accurate predictive techniques for increasingly complex configurations is an evolutionary one. The planned research will examine methods capable of extending the previous wing work of Jameson and Caughey to include the added complexity of a fuselage. The investigation will be conducted within the framework of the complete potential equation. The major effort will be devoted to the development of differencing procedures in conservation form.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

7.0005, METEOROLOGICAL DATA PROCESSING SOFTWARE

F.L. Staffanson, Utah Higher Education System, University of Utah, School of Engineering, Dept. of Electrical Engineering/ Computer Science, *1400 E. 2nd S., Salt Lake City, Utah* 84112 (NAG 6-8)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Wallops Flight Center

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, PROPERTIES OF BULK AND LAYERED III-V *SEMICONDUCTOR COMPOUND FOR ELECTRO-OPTIC* COMPONENTS

H.H. Caspers, U.S. Dept. of Defense, Navy, Naval Ocean Systems Center, Electronics Engineering & Sciences Dept., *San Diego, California* 92152 (DN887544)

Determine the optical properties of bulk and layered III-V compound semiconductors.

Determine the index of refraction and extinction coefficient as a function of energy. Measure and calculate pertinent optical properties from reflection and transmission spectra obtained from bulk and layered structures of III-V compound semiconductors. Obtain excitation and emission spectra on $Ga(x)In(1-x)As(x)P(1-y)/InP$. Special emphasis will be devoted to III-V structures for use as photovoltaic detectors for the wavelength region beyond 1 micrometer.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Ocean Systems Center

***8.0002, SOME THEORETICAL STUDIES OF THE* PROPERTIES OF CONDENSED MATTER**

P.A. Pincus, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (DMR78-10312)

Research previously supported by DMR7519544.

Theoretical research in condensed matter physics will be carried out. Some of the topics to be studied will include: quantal adiabatic hopping; hopping in the ultra-weak dispersion regime; hopping in a molecular crystal with Morse-type intramolecular vibrational potentials; higher-order multiphonon calculations; the mechanism of self-trapping of electrons, holes and excitons; excitation transfer in disordered systems; spin flip scattering near the glass transition in spin-glasses; magnetic anisotropy of strongly mixed magnetic moments in dilute magnetic alloys; fluctuations in superconductors near the critical temperature; macromolecular physics; polyelectrolytes; deformed entangled polymer solutions; and nematic polymers.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0003, MAGNETIC FIELD LINE RECONNECTION EXPERIMENTS

R.L. Stenzel, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Physics, *405 Hilgard Ave., Los Angeles, California* 90024 (ATM79-21331)

A two-year program for continued investigations on laboratory magnetic field line reconnection in plasmas will be supported. The research will concentrate on three-dimensional time-resolved measurements of electric fields, magnetic fields, and particle flows. With these detailed data the energy transfer from magnetic fields to kinetic particle energies will be established. The role of microinstabilities will be critically examined. The overall aim is to understand space plasma dynamics by means of laboratory simulations.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

8.0004, MANY-BODY CONDENSED MATTER

D.J. Scalapino, University of California, Santa Barbara Campus, School of Letters & Science, Dept. of Physics, *Santa Barbara, California* 93106 (DMR80-01492)

Research previously supported by DMR7617373.

Theoretical research will be carried out in three different areas: (1) phase transitions in two dimensional systems, such as an adsorbed layer on a solid surface; (2) light emission from tunnel junctions, particularly the role of surface plasmon excitations, and; (3) pion radiation and neutrino transport problems, such as the Cherenkov radiation of pions arising from a nucleon passing through nuclear matter and the properties of neutrino pulses emitted during a supernova.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0005, *NEW EFFECTS IN MULTIPHOTON ATOMIC* AND MOLECULAR PROCESSES

P.P. Lambropoulos, University of Southern California, School of Letters Arts & Sciences, Dept. of Physics, *3551 University Ave., Los Angeles, California* 90007 (PHY78-23812)

Research in theoretical atomic physics initiated under NSF grant PHY76-23163A01 will be continued. Among topics in multiphoton processes to be investigated are: 1) atomic structure calculations; 2) electric quadrupole effects; 3) photon correlation effects; 4) AC Stark splitting; 5) light-polization and electron-spin effects; 6) resonance effects; 7) quantum beat phenomena; 8) resonant harmonic generation; 9) strong field effects; 10) resonance multiphoton processes; and 11) stochastic properties of nonmonochromatic fields.

These investigations will deal with basic aspects of multiphoton processes as well as their application to spectroscopy, laser isotope separation and ionization under very strong fields.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0006, LASER SPECTROSCOPY OF SOLID STATE ELECTROLYTES

J.F. Scott, University of Colorado, Boulder Campus, School of Arts & Sciences, Dept. of Physics & Astrophysics, *1200 University Ave., Boulder, Colorado 80302 (DF046000; AFOSR-77-3105)*

AF function - this proposed research primarily falls in the 5.3 research objectives which deal with electrical power from non-nuclear energy sources. In particular, the use of superionic conductors as solid electrolytes has high potential for development of new batteries and energy storage devices. These batteries will be used for electrical power unattended ground based systems. Deficiency - substantial improvements are needed in organic and solid electrolytes to increase conductivity to that achieved in aqueous electrolytes. These solid electrolytes have a much wider temperature range and are needed to be used in new high energy, high charge and discharge rates rechargeable batteries in future aircraft applications as well as space applica-

tions. Objective - laser spectroscopy is to be used to study electrolytes of the silver-iodide tungstate system, which includes at least three phases. These electrolyte phases are among the most promising for silver-iodine batteries. Related studies are proposed on pyridinium silver iodide. Contribution - this research is a part of a comprehensive program in superfluids and superconductors.

Pure silver tunstate crystallizes in two forms. The so-called high-temperature modification is stable (or metastable) at room temperature and has a C(2V) point group symmetry. Although it is only slightly distorted from a centric D(2H) structure, efforts to switch its pyroelectric domains with fields up to 40kV/cm have been unsuccessful. The main thrust of the spectroscopy is to determine high-temperature structural and chemical information concerning Ag(2)WO(4) and its iodated forms, for example, the presence of structural phase transitions, the onset and degree of disorder, evidence for mobility of silver ions, stability in oxygen, and irreversible chemical degradation. These studies differ considerably from the infrared and Raman spectroscopy done previously on the silver aluminates and gallates and the calcium fluoride family, where primary emphasis has been upon the microscopic details of ag ion hopping. Our attention is focussed on more practical aspects, important to device fabrication, of stability and decomposition.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0007, INNER-SHELL EXCITATIONS IN HEAVY ION-ATOM COLLISIONS

Q.C. Kessel, University of Connecticut, Storrs Campus, School of Liberal Arts & Sciences, Dept. of Physics, *Storrs, Connecticut 06268 (PHY78-06723)*

A comprehensive experimental study of the excitation of inner electron shells in heavy atoms during high-energy ion-atom collisions will continue. This investigation will shed light on the quasimolecular processes (in particular, curve crossing phenomena) which occur at small internuclear separations. These small internuclear separations can only be achieved by high-energy collision processes. The techniques which have been applied in the investigations include both coincidence and scattered particle measurements of the inelastic energy loss, the determination of scattered charge states and the measurement of relative cross sections for X-ray emission. New experiments will provide detailed information on the couplings which give rise to diabetic molecular orbitals in very heavy ion-atom collisions. The results will be compared with the model of Fano and Lichten, with extensions of this model by Barat, Lichten, Eichler and co-workers, and with predictions of recent theoretical work by Schmid and Garcia.

This is a continuation of work currently supported by NSF Grant PHY76-10352 A01.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0008, NUMERICAL SIMULATION AND DESIGN OF PULSE

T. Coffey, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia 20375* (DN320106)

To perform theoretical and numerical studies in support of the pulsed power experimental program at NRL. The objective of the overall program is to conduct research leading to construction of an experimental device used for the generation of high energy density sources, i.e., X-ray sources, ion sources, plasma and electrical energy.

This program will utilize theoretical and experimental techniques to study advanced concepts in plasma physics as applied to pulsed power systems. In particular, studies will be undertaken of energy generation, power conditioning, transport and delivery to plasma loads.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0009, EUV PLASMA SPECTROSCOPY

G.A. Doschek, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN980042)

Determine physical conditions such as electron temperature, density, turbulence, and mass motions in million degree laboratory plasmas. Develop new laboratory spectrographs based on recent developments in astronomical detector technology.

Modify and adapt existing solar physics spectrographs and hardware to laboratory facilities. Plasmas to be studied include laser-produced plasmas, low inductance vacuum spark plasmas, electron-ion beam plasmas and tokamak plasmas.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0010, PHOTOSTRUCTURAL PROPERTIES OF SEMICONDUCTORS

P.C. Taylor, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN980024)

To investigate the structural properties of disordered semiconductors and to characterize and understand the nature of optically-induced structural changes (photo-structural effects) in disordered semiconductors. Such information is necessary to evaluate the potential usefulness of these materials as optical and electro-optical components.

The structural and photo-structural properties of crystalline disordered semiconductors are investigated by use of several spectroscopic and resonant techniques including infrared, far infrared, and sub-millimeter wave spectroscopy, microwave dielectric loss measurements, Raman spectroscopy, nuclear magnetic resonance (NMR) and nuclear quadrupole resonance (NQR). The results are used for testing current theories for disordered and crystalline semiconductors and for inventing new devices which utilize the unique properties of these solids.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

8.0011, INTERACTIONS OF RADIATION WITH POSITIVE IONS AND NEUTRAL ATOMS 14560-P

S.T. Manson, Georgia State University, School of Arts & Sciences, Dept. of Physics, *33 Gilmer St. S.E., Atlanta, Georgia* 30303 (DA0F8955; DAAG29 77 G0068)

To perform theoretical investigations of the interaction of charged particles and electromagnetic radiation with positive ions and neutral atoms and determine the details of the mechanisms of energy deposition. Relevance: The research is directly related to ongoing work at BRL in the areas of (1) nuclear weapon's effects and (2) the X-ray laser.

A first principles quantum mechanical calculation of cross sections of photoionization from individual atomic subshells, phase shifts, inelastic scattering form factors, generalized oscillator strengths will be performed.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0012, INTERACTIONS OF RADIATION WITH POSITIVE IONS AND NEUTRAL ATOMS 16853-P

S.T. Manson, Georgia State University, School of Arts & Sciences, Dept. of Physics, *33 Gilmer St. S.E., Atlanta, Georgia* 30303 (DA0G1791; DAAG29-80-C-0027)

In a theoretical program of atomic collisions, calculations are proposed in which the interaction of charged particles and electromagnetic radiation with positive ions and neutral atoms will be explored and the details of their deposition of energy investigated. Relevance: The research is relevant to particle beam technology, X-ray propagation and also relevant to radiation energy deposition mechanisms.

Self-Consistent-Field, Hartree-Fock, Hartree-Slater, relativistic as well as non-relativistic calculations will be performed; exchange and correlation effects will be taken into account.

SUPPORTED BY U.S. Dept. of Defense, Army Materiel Development & Readiness Command, Army Research Office

8.0013, COMPUTER SIMULATIONS OF MAGNETIC SYSTEMS

D.P. Landau, University of Georgia, Franklin College of Arts & Sciences, Dept. of Physics & Astronomy, *Athens, Georgia* 30601 (DMR79-26178)

Research previously supported by DMR7611329.

Theoretical research in statistical mechanics as applied to condensed matter physics will be carried out. In particular, the thermal and magnetic properties of a variety of magnetic and lattice gas systems will be studied using several computer simulation techniques such as the Monte Carlo, the Monte Carlo renormalization group, and spin dynamics methods. Emphasis will be placed on the examination of models exhibiting multicritical phenomena in two and three dimensions. These studies will include the location of phase boundaries and multicritical points, and an examination of the associated critical behavior. Detailed studies of impure and random systems will be pursued, as well as investigations of models with long range interactions.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0014, EXCITATION OF SOLIDS BY SYNCHROTRON RADIATION

F.C. Brown, University of Illinois, Urbana Champaign Campus, School of Engineering, Dept. of Physics, *106 Engineering Hall, Urbana, Illinois* 61801 (DMR79-13103)

Experimental research using the unique properties of synchrotron radiation to study inner shell excitations in solids will be carried out. The work will be carried out primarily at the Synchrotron Radiation Center, Stoughton, Wisconsin, where the new storage ring, Alladin, is being built. A beam line will be instrumental for producing intense monochromatic beams of photons with energies up to 2600 eV. This will be used to study radiation induced defects and damage mechanisms in semiconductors and insulators. The emphasis will be on de-excitation processes including photolysis and color center production in insulators and radiation damage in semi-conductors.

This is a continuation of research previously supported by NSF grant DMR-7620644.

This is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0015, DOUBLE MONOCHROMATOR FOR ATMOSPHERIC TRANSMISSION AND UNDERWATER MEASUREMENTS

W.G. Fastie, Johns Hopkins University, School of Arts & Sciences, *Dept. of Physics, 34th & Charles Sts., Baltimore, Maryland* 21218 (7-716; NA80-SAC-00624)

OBJECTIVE: The objective of this grant is to improve the stability of a new double monochromator system, developed by Professor Fastie, for atmospheric transmission measurements, to develop an underwater housing to allow the monochromator to be used for underwater measurements and to carry out field tests to verify performance.

APPROACH: The detector systems in use in the present monochromators will be improved to increase stability, a new underwater housing will be produced and tested and Professor *Fastie and his assistants will participate in field experiments to* verify the performance of the system.

PROGRESS: The basic monochromator design has been completed and two instruments produced. A sun-tracking holder has been produced for the atmospheric transmission measurements.

SUPPORTED BY U.S. Dept. of Commerce, National Environmental Satellite Service, Satellite *Experiment Lab.*

8.0016, LASER, X-RAY AND GAMMA-RAY SPECTROSCOPY

R.D. Deslattes, U.S. Dept. of Commerce, National Bureau of Standards, Center for Absolute Physical Quantities, *Rte. 270, Gaithersburg, Maryland* 20234 (52002)

OBJECTIVE: To improve our understanding of the spectra of simple atoms for theoretical comparisons, to achieve a better understanding of the finer details of X-ray spectra of atoms, molecules, simple solids, and atmospheric and laboratory plasmas, to extend the optical wavelength scale to the X- and gamma-ray regions and to apply high resolution instrumentation to complex gamma-ray spectra.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards, Center for Absolute Physical Quantities

8.0017, RADIATING GASEOUS MEDIA

A.V. Phelps, U.S. Dept. of Commerce, National Bureau of Standards, Center for Absolute Physical Quantities, *Rte. 270, Gaithersburg, Maryland* 20234 (52514)

OBJECTIVE: Develop experimental methods and theoretical models for the determination of the interaction of high intensity radiation with atoms and molecules, for the measurement of the physical properties of solar and astrophysical plasmas, for the measurement of radiant energy from X-rays to visible, and for the evaluation of electrical discharge pumping of selected radiating gases such as laser media.

SUPPORTED BY U.S. Dept. of Commerce, National Bureau of Standards, Center for Absolute Physical Quantities

8.0018, THERMAL AND SUPRATHERMAL ION COMPOSITION STUDIES CLOSE TO THE SUN

G. Gloeckler, University of Maryland, College Park Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *College Park, Maryland* 20742 (NAGW 101)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

8.0019, THE ELECTRON-PHONON INTERACTION IN TANTALUM - INFLUENCES OF TUNNEL JUNCTION *DESIGN*

J. Bostock, Massachusetts Inst. of Technology, School of Science, Dept. of Physics, *77 Massachusetts Ave., Cambridge, Massachusetts 02139* (MCS80-08303)

Tunneling experiments into sputtered film junctions of various designs will be the bases for a systematic investigation of strong-coupling super-conductivity in tantalum. This research will complement on-going research into the properties of single crystal, polycrystalline, and disordered samples of niobium, tantalum and vanadium. The goal of this research is to provide a definitive microscopic characterization of super-conductivity in the Group VB transition metals.

This is a continuation of research supported under NSF Grant DMR 78-07202.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0020, PROBLEMS IN QUANTUM AND CLASSICAL STATISTICAL MECHANICAL SYSTEMS

R.A. Guyer, University of Massachusetts, Amherst Campus, School of Arts & Sciences, Dept. of Physics & Astronomy, *Amherst, Massachusetts* 01002 (DMR79-09592)

Research previously supported by DMR7614447.

Theoretical research in quantum and classical statistical mechanics will be carried out in three areas: (1) magnetic proper-

ties of liquid and solid helium, (2) quantum fluid mixtures and in homogeneous quantum fluid systems, and (3) the equilibrium and non-equilibrium statistical mechanisms of non-linear systems.

This is the first year of two-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0021, MILLIMETER-MICROWAVE INVESTIGATION OF METALS

G.L. Dunifer, Wayne State University, School of Liberal Arts, Dept. of Physics, *4841 Cass Ave., Detroit, Michigan* 48202 (DMR79-13786)

The research to be carried out consists of three parts. First, the fundamental characteristics of the conduction electrons in the simplest of all metals (the alkali metals) will be studied by using a millimeter microwave transmission spectrometer. The use of millimeter microwave frequencies greatly enhances collective, many-body effects resulting from exchange and correlations between the conduction electrons. Such observations are expected to resolve several types of new wave propagation, including those associated with quantization of the electron's orbital motion. The observations may also answer the fundamental question of whether the electronic ground state of potassium is a Charge Density Wave. Secondly, the conduction electron spin resonance of palladium will be investigated with the transmission spectrometer. Palladium has a strongly enhanced spin susceptibilty, and spin resonance observations at high frequency may resolve the suspected spin wave sidebands that accompany the fundamental resonance. Such measurements will produce an accurate determination of the exchange enhancement factor of palladium. Finally, electron spin resonance spectra will be taken as a function of frequency on amorphous magnetic systems. This will be part of a group project to conduct a comprehensive investigation on problems of current interest in this type of magnetic system.

This is the first year of a three year continuing grant. This is a continuation of research previously supported by NSF grant DMR-7200181.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0022, SINGLE-PARTICLE AND PAIR TUNNELING SPECTROSCOPY OF SUPERCONDUCTORS

A.M. Goldman, University of Minnesota, Minneapolis Campus, Inst. of Technology, Dept. of Physics, *105 Morrill Hall, Minneapolis, Minnesota* 55455 (DMR80-06959)

This is a continuation of research supported under DMR-7808513.

Electron tunneling will be used to investigate a variety of problems in superconductivity. Sing'l-particle tunneling will be employed to probe the electron-phonon interaction in the A15 superconductors Nb3Ge and V3Si work which involves the development of an artificial barrier tunneling technology. These studies will be carried out on Nb3Ge films grown by polycrystalline epitaxy and on single crystals of 3V3Si. Pair tunneling will be used to determine the wave-vector and frequency-dependent pair-field susceptibilities of clean-limit and gapless superconductors and superconductors in a current-carrying state. The damping of the propagating 'transverse' mode of the order parameter will be measured in each of these regimes. The onset of electrical resistance in thin (2D) amorphous Nb3Ge films will be studied. This work is intended to test theories of flux-flow resistance above the topological transition temperature. The quantum interference phenomenon will be investigated in thin amorphous Nb3Ge films with the goal of studying the possible universal relationship between the topological transition temperature and the jump in the superfluid density at the transition.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0023, TRICRITICAL PHENOMENA AND DYNAMICS OF HYDROGEN-BONDED CRYSTALS

V.H. Schmidt, Montana State University, School of Letters & Sciences, Dept. of Physics, *Bozeman, Montana* 59715 (DMR78-09205 A01)

The 'critical' point in a liquid-gas system is the temperature and pressure at which it is impossible to distinguish between the liquid and gas, i.e., the surface tension goes to zero. Other types of systems, such as magnetic systems, superfluids, and those with turbulent flow also show critical phenomena. A recent major development in a unified theoretical treatment of all these phenomena. The importance of Professor Schmidt's work is that the ferroelectric, hydrogen bonded salts (such as KH2PO4) are different from other types of systems studied, have four variables that can be changed at will, and thus offer a specially favorable opportunity to examine dynamic effects near tricritical points and to test theory of critical phenomena.

Static and dynamic phenomena associated with phase transitions are investigated in potassium hydrogen (or deuterium) phosphate-type ferroelectric crystals by means of dielectric, nuclear magnetic resonance, birefringence, Brillouin scattering, and/or neutron scattering measurements. These measurements are made at various temperatures and pressures, with various applied electric fields, and with varying degrees of deuteration to examine behavior near the critical lines in temperature-pressure-electric field space and near the tricritical point which occurs at about 2.4 kbar in KH2PO4.

This is a continuation of work supported under DMR 76-11828.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0024, DIFFUSION LENGTH MEASUREMENTS IN GALLIUM ARSENIDE AND OTHER III-IV SEMICONDUCTOR COMPOUNDS

J.A. Woollam, University of Nebraska, Lincoln Campus, School of Arts & Sciences, Dept. of Physics, *Lincoln, Nebraska* 68508 (NAG 3-120)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Lewis Research Center

8.0025, EXTRAGALACTIC ASTROPHYSICS - YOUNG GALAXIES AND INTERGALACTIC MEDIUM

J.P. Ostriker, Princeton University, School of Natural Sciences, Dept. of Astrophysical Sciences, *Box 430, Princeton, New Jersey* 08540 (NAGW 120)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Office of Space Science

8.0026, THEORETICAL SOLID-STATE PHYSICS

E. *Abrahams,* Rutgers the State University of New Jersey, New Brunswick Campus, School of Arts & Sciences, Dept. of Physics, *Old Queens Bldg., New Brunswick, New Jersey* 08903 (DMR79-21360)

Research in theoretical solid-state physics carried out under grant DMR72-03230 will be continued. In particular, the program will be directed toward three general problems: (1) Transport coefficients of the normal Fermi liquid will be calculated by extending Eliashberg's theory to include finite temperature corrections. (2) The coupling of electrons to sound waves in piezoelectric materials will be studied, including the effect of this coupling on transport properties. (3) Research on dynamical phenomena near the lambda transition in liquid helium will be continued.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0027, RESONANCES UTILIZING MULTIPARTICLE SPECTROMETERS

S.J. Lindenbaum, City University of New York, City College, School of Liberal Arts & Sciences, Dept. of Physics, *Convent Ave. & 138th St., New York, New York* 10031 (PHY80-09788)

This proposal is to carry out research in elementary particle physics using the multiparticle spectrometer facility at Brookhaven AGS. The experiments will include high sensitivity studies of the production of meson resonances decaying into phi and phi channels, a continuing search for the existence of baryonium states, and search for associated CHARM production.

This is the first year of a two-year continuing grant previously supported under NSF award PHY77-20225.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Physics

8.0028, ELECTRON SPIN RESONANCE

R.H. Silsbee, Cornell University, Ithaca Campus, Lab. for Atomic & Solid State Physics, *Clark Hall, Ithaca, New York* 14850 (DMR80-08546)

The electron spin resonance technique will be applied to the study of electron structure of metals and of mechanisms of spin transport in metals and across metal-metal interfaces. The work will focus on experiments utilizing ferromagnetic films deposited on normal paramagnetic metals. One experiment utilizes films of palladium:iron alloys, with the Curie temperature determined by alloy composition, to probe in detail the mechanism of resonance enhancement by thin films. A second project exploits the enhancement to search for the detailed dependence of the electronic g-factor upon wave vector for pure aluminum single crystals. A third involves the development of a novel technique for coupling to the magnetic resonance in metals, taking advantage of the fact that associated with electric currents between a ferromagnetic and normal metal there will also be flow of magnetization.

This research was previously supported under NSF Grant No. DMR-7708464.

This is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0029, HIGH-TEMPERATURE PLASTIC FLOW IN A15 SUPERCONDUCTING COMPOUNDS

R.N. Wright, Rensselaer Polytechnic Inst., School of Engineering, Dept. of Materials Engineering, *110 8th St., Troy, New York* 12181 (DMR78-05726)

This is a continuation of research on the high-temperature plastic deformation of A15 superconducting compounds. Continued use will be made of hot isostatic pressing to produce low-porosity materials with maximal A15 matrix phase content. The effects of refined grain size on stress-strain rate-temperature (S-SR-T) response will be evaluated through study of Zr-doped Nb3Sn. A refined grain size should facilitate plastic deformation by abetting diffusional flow deformation mechanisms, and is required to achieve enhanced critical current values. The effects of variations from stoichiometry on S-SR-T response will be studied on a range of V3Ga specimens. Thorough microstructural characterization will be undertaken. Mechanical behavior will be evaluated through the use of deformation mechanism mapping techniques, in an effort to identify micromechanism of deformation, and to provide a basis for comparison with other materials. Critical temperature, critical current and low-temperature heat capacity measurements will be undertaken, and the results obtained correlated with microstructural observations and mechanical behavior in order to assess the effect of high-temperature deformation on superconducting properties. A detailed consideration of dislocation geometry and motion in A15 compounds will be done using electron transmission microscopy. An evaluation of the influence of hydrostatic pressure on high-temperature Nb3Sn fracture behavior will be performed using constrained plastic flow testing analogous to direct extrusion. The results of this study are expected to serve as a scientific basis from which it may be possible to control deformation processing parameters in order to achieve acceptable superconducting properties in A15 and related superconducting materials. This is a continuation of research, previously funded under NSF Grant DMR76-00554. This is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0030, STRUCTURE OF DISORDERED SYSTEMS DETERMINED BY FREQUENCY DERIVATIVE X-RAY DIFFRACTION

N.J. Seewchik, State University of New York, Stony Brook Campus, School of Arts & Sciences, Dept. of Physics, *Stony Brook, New York* 11790 (DMR77-28542)

Standard X-ray diffraction techniques will be extended by the development of frequency modulation X-ray diffraction methods. This will add the dimension of elemental tunability--the ability to observe the contributions of a particular element to the scattering of the X-rays. The ability to observe a particular element arises from the fact that near the characteristic absorption edge of that element, the derivative of the scattered x-ray intensity with respect to the X-ray frequency is dominated by the interference of X-rays about that element. The Fourier transforms of such derivative data yield directly the radial distribution of neighboring atoms about that element. This method will be applied to the study of amorphous materials to demonstrate the potentials and limitations of the technique.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0031, POINT DEFECTS IN IONIC CRYSTALS ROLE OF THE SURFACE CHARGE

L.M. Slifkin, University of North Carolina, Chapel Hill Campus, Graduate School, Dept. of Physics, *Chapel Hill, North Carolina* 27514 (DMR78-09198)

Surfaces of ionic crystals generally are electrically charged because of an excess of surface kinks of one sign. The compensating ionic space charge has a depth of about 0.1 micron, across which there is a potential difference often of about 0.2 volt. Very large perturbations of concentrations of point defects in this region give rise to a number of interesting and important effects. This phenomenon is being studied in the silver halides, which are attractive media because of the firm groundwork already established (a result of the importance of these effects to the photographic process) and also because the very high ionic conductivity of the space charge layer makes possible experiments not feasible with other materials. The following experiments are performed: (1) Space charge is studied by measuring the conductivity as a function of thickness of evaporated films, and of various adsorbed species. (2) Equilibrium concentrations, at various temperatures, of divalent dopants, are determined as a function of depth below the surfaces of single crystals. (3) An experiment not involving surface charge phenomena is suggested by the diverse ways in which iodide addition affects the properties of AgCl and AgBr photographic emulsions; elastically bound complexes between I and point defects are to be sought.

This is the first year of a three-year continuing grant.

It is a continuation of work supported by DMR 76-18862.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0032, MAGNETIC RESONANCE IN FERROMAGNETIC DOMAIN WALLS

P.E. Wigen, Ohio State University, Columbus Campus, School of Mathematics & Physical Sciences, Dept. of Physics, *164 W. 17th Ave., Columbus, Ohio* 43210 (DMR80-07642)

Using two recently developed techniques, experimental investigations into dynamical properties of magnetic domain walls will be carried out. Using a broadband RF slot line structure, the domain wall resonance can be observed with sensitivity two to three orders of magnitude greater than by previously used optical procedures. As a result, it is possible to investigate dynamic properties of domain walls for in-plane fields strong enough to saturate the magnetizations in the film plane. The ex-

perimental results cannot be explained by present 'canted Bloch wall' theories and new models are being proposed. The second experiment involves the excitation of spinwaves at magnetic domain walls. These experiments indicate a damping parameter for these spinwaves to be quite different from those observed for the uniform resonance mode and perhaps related to domain wall mobilities. This possible relationship will be further investigated.

This research was previously supported under NSF Grant No. DMR-7810300.

This is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0033, MECHANISMS OF PORE, DISLOCATION AND PRECIPITATE NUCLEATION AND GROWTH DURING HIGH TEMPERATURE ION BOMBARDMENT

W.J. Choyke, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics & Astronomy, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (DMR78-02598)

Many metals subjected to atomic displacement damage exhibit complex microstructural changes not seen under normal thermal equilibrium conditions. In all cases the evolution of the microstructure involves competitive nucleation and growth processes which proceed by the diffusion and aggregation of point defects and impurities. While there is a large body of experimental data and theory which has identified and examined in detail the mechanisms of point defect diffusion and clustering at low temperatures and damage levels in many metals and alloys, the mechanisms at temperatures and atomic displacement levels of interest to the new fields of implantation metallurgy and simulation of fast neutron effects remain largely unexplored. The purpose of this program is to identify the mechanisms of diffusion and aggregation of point defects and impurities involved in the nucleation and growth of voids, dislocation loops and precipitates under ion bombardment at temperatures high enough for self-diffusion to occur. Two coimpinging beams of helium ions and silicon ions are used to simultaneously produce lattice damage and introduce an isoluble impurity. In single crystals of copper, molybdenum and polycrystalline type 304 stainless steel, ion channeling, anelastic relaxation and transmission electron microscopy measurements will be used to determine impurity site occupancy, nature of the impurity-point defect aggregates, and the kinetics of diffusion and precipitation. The mechanisms of diffusion and aggregation of point defects and impurities will be identified by reconciling the measured properties with nucleation and growth reaction rate theories. This is a continuation of research previously funded under NSF Grant DMR75-01032 A02. This is the first year of a three year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0034, CRITICAL PHENOMENA AND PHASE TRANSITIONS

D.M. Jasnow, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics & Astronomy, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (DMR80-02416)

Research previously supported by DMR7619443.

Theoretical research will be carried out on the behavior of inhomogeneous condensed matter systems. These systems include surfaces, interfaces and magnetic clusters. In particular, the integration of the method of constrained partition functions into a general renormalization group approach will be pursued. Specific application to the behavior of a two-phase critical interface and a defect-associated magnetic cluster will be made. Extensions of the general method will allow a first-principles treatment of the dynamics of interfaces and clusters. Other projects will include further work on spin models with competing interactions and an exploratory project on the condensation of vacancies in metals.

This is the first year of a three-year continuing grant.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0035, SMALL ANGLE NEUTRON SCATTERING FROM FERROFLUIDS

A.C. Nunes, University of Rhode Island, School of Arts & Sciences, Dept. of Physics, *Kingston, Rhode Island* 02881 (DMR78-03024)

A ferrofluid (a collodial suspension of magnetic particles) is a magnetic fluid which has unique applications in rotating seals and particle separators. As a collection of subdomain sized particles a ferrofluid is a physically interesting magnetic system, a superparamagnet, whose properties are presumably dominated by surface phenomena, because of their relatively large surface to volume ratio. Several measurements of ferrofluids have demonstrated magnetic properties significantly different from the bulk materials. Most of these techniques measure volume averages however, and there is little direct information of the magnetic structure of the particles themselves. A polarized neutron small angle scattering investigation of a ferrofluid will be undertaken to ascertain the chemical makeup and magnetic structure of a colloidal ferrite suspended in water. This will be the first application of small angle neutron scattering to such a system. Results will be compared with model predictions. Experience gained in this work may also have technological ramifications in the field of polarized neutron scattering as a polarizing filter.

SUPPORTED BY U.S. National Science Foundation, Directorate for Mathematical & Physical Sciences, Div. of Materials Research

8.0036, THE ROLE OF COHERENT STRUCTURES IN THE GENERATION OF NOISE FOR SUBSONIC JETS

G.L. Morrison, Texas A & M University, College Station Campus, School of Engineering, Dept. of Mechanical Engineering, *P.O. Box F E 44, College Station, Texas* 77843 (NAG 1-112)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Langley Research Center

8.0037, INNOVATIVE PROJECTS IN ELECTROMAGNETISM

D.G. Torr, Utah Higher Education System, Utah State University, School of Science, Dept. of Physics, *Main Bldg., Office 104, Logan, Utah* 84321 (NAGW 119)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

8.0038, A STUDY OF MAGNETOSPHERIC/IONOSPHERIC/ATMOSPHERIC COUPLING VIA ENERGETIC HEAVY IONS

M.R. Torr, Utah Higher Education System, Utah State University, School of Science, Dept. of Physics, *Main Bldg., Office 104, Logan, Utah* 84321 (NAGW 105)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, DEVELOPMENT OF INSB DECTECTORS FOR SUBMILLIMETER ASTRONOMY

T. Phillips, California Inst. of Technology, Graduate School, Dept. of Physics Mathematics & Astronomy, *1201 E. California Blvd., Pasadena, California* 91109 (NAGW 107)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

10.0002, ULTRAVIOLET SURVEY OF BE STARS
G.G. Spear, California State University & Colleges, California State College, Sonoma Campus, School of Liberal Studies, Dept. of Physics & Astronomy, *1801 E. Cotati Ave., Rohnert Park, California* 94928 (NAG 5-115)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0003, COMPUTER SIMULATIONS OF VERY LOW FREQUENCY (VLF) WAVE-PARTICLE INTERACTIONS IN THE MAGNETOSPHERE
R.A. Helliwell, Stanford University, School of Engineering, Dept. of Electrical Engineering, *Stanford, California* 94305 (NAG 5-120)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0004, A THEORETICAL STUDY OF THE X-RAY EMMISSION FROM CLUSTERS OF GALAXIES
W.H. Tucker, University of California, Irvine Campus, School of Physical Sciences, Dept. of Physics, *Irvine, California* 92664 (NAGW 109)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

10.0005, HIGH-PRESSURE COSMOCHEMISTRY APPLIED TO MAJOR PLANETARY INTERIORS (EXPERIMENTAL STUDIES)
M.F. Nicol, University of California, Los Angeles Campus, School of Letters & Science, Dept. of Chemistry, *405 Hilgard Ave., Los Angeles, California* 90024 (NAGW 104)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

10.0006, SEARCH FOR SHELL LINES AND VARIABILITY IN THE ULTRAVIOLET SPECTRUM
G.J. Peters, University of Southern California, School of Letters Arts & Sciences, Dept. of Astronomy, *3551 University Ave., Los Angeles, California* 90007 (NAG 5-126)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0007, A STUDY OF THE IO PLASMA TORUS
D.E. Shemansky, University of Southern California, School of Letters Arts & Sciences, Dept. of Astronomy, *3551 University Ave., Los Angeles, California* 90007 (NAGW 106)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Office of Space Science

10.0008, OSCILLATIONS OF THE SUN AS A PROBE OF LARGE-SCALE SOLAR ACTIVITY AND SOLAR-TERRESTRIAL RELATIONS
E.J. Rhodes, University of Southern California, School of Science, Dept. of Astronomy, *3551 University Ave., Los Angeles, California* 90007 (ATM80-09469)

This grant will support for a recently-developed, ground-based solar velocity field instrument. This instrument, which is currently under construction at the Mount Wilson Observatory, and which should be completed by late-June, 1980, will be dedicated to the seismic probing of solar structures on a regular basis. This goal will be reached through the combination of a diode array camera, a mini-computer, a high-speed array processor, a control microprocessor, and a large-volume data storage system with the existing 60 foot Mt. Wilson tower telescope. With this equipment it will be possible to obtain extensive digital observations of the solar photospheric velocity field at relatively high time resolution for durations of up to 12 hours in order to search for temporal variations in the photospheric and subphotospheric rotation rates on time scales down to one day. This system will also permit a search for possible flare-generated oscillations, short-period acoustic waves, and large-scale convective flaws. Such observations will allow a study of the possible impact of solar variability upon our terrestrial environment.

SUPPORTED BY U.S. National Science Foundation, Directorate for Astronomical Atmospheric Earth & Ocean Scis., Div. of Atmospheric Sciences

10.0009, SOLAR PHYSICS
G.E. Brueckner, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (DN920046)

A capability is needed to forecast increases in solar short wavelength radiation (solar flares) and in solar particle emission, since these produce ionospheric and geomagnetic disturbances which adversely affect radio communication, over the horizon radar, guidance-control, and detection.

Solar ultraviolet instrumentation is flown in rockets to measure the ultraviolet emission which is concentrated in small volume elements on small areas of the sun. A new high resolution telescope and spectrograph (HRTS) has been prepared for this purpose.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

10.0010, DIFFERENCES BETWEEN COMPACT AND DOUBLE RIBBON SOLAR FLARES
D.S. Spicer, U.S. Dept. of Defense, Navy, Naval Research Lab., *4555 Overlook Ave. S.W., Washington, District of Columbia* 20375 (INT79-16914)

This award will support Dr. Daniel Spicer of the Naval Research Laboratory in Washington, D.C. for a period of two years in a program of cooperative research with Professor Eijiro Hiei of Tokyo Astronomical Observatory in Japan for the purpose of studying the differences between the two distinguishable classes of solar flares: compact loop flares and large double ribbon flares. The study involves the comparison of all available data from both Japanese and U.S. sources in elucidating the conditions for the occurrence of the flare. A detailed comparison of the results obtained from both observations and theory may yield valuable information on the conditions for the occurrence of double ribbon flares and the energy release mechanism operating in them. This project is sponsored jointly by NSF and by the Japan Society for the Promotion of Science under the U.S.-Japan Cooperative Science Program.

SUPPORTED BY U.S. National Science Foundation, Directorate for Scientific Technological & Internat. Affairs, Div. of International Programs

10.0011, ULTRAVIOLET OBSERVATIONS OF AN INTERSTELLAR CLOUD WITH ANOMALOUS DEPLETIONS
P.C. Frisch, University of Chicago, School of Physical Sciences, Dept. of Astronomy & Astrophysics, *5734 S. Ellis Ave., c/o Hinds Geophysics Lab., Chicago, Illinois* 60637 (NAG 5-125)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0012, STUDY OF THE PROPERTIES OF TERRESTRIAL AURORAL KILOMETRIC RADIATION
M.M. Baumback, University of Iowa, School of Liberal Arts, Dept. of Physics & Astronomy, *Jessup Hall, Iowa City, Iowa* 52240 (NAG 5-118)

SUPPORTED BY U.S. National Aeronautics & Space Admin., Goddard Space Flight Center

10.0013, SOLAR RADIO PROGRAMS AT THE HARVARD RADIO ASTRONOMY STATION
A. Maxwell, Harvard University, Cambridge Campus, School of Arts & Sciences, Dept. of Astronomy, *Cambridge Station, Cambridge, Massachusetts* 02138 (ATM80-07024)

This grant will support the continuation of a program in solar radio astronomy being carried out at the Harvard Radio

Astronomy Station, Fort Davis, Texas. Observations of radio emissions from solar flares will be made, on a second-by-second basis, daily throughout the year, with new dynamic spectrum analyzers of high sensitivity, covering the band 25 to 580 MHz. Additional data will be taken at selected times with spectrum analyzers of high sensitivity covering the band 550 to 2000 MHz. One of the chief aims of the program is the study of solar radio bursts of spectral type II, which provide an important diagnostic for propagation of shock waves generated by flares. Radio data on the shocks will be compared with computer simulations of the passage of fast-mode magnetohydrodynamic shocks in the solar corona. The radio information and the computer simulations will then be related to data on high-velocity coronal transients taken with optical equipment, and to the characteristics of the shocks in the interplanetary medium as determined by satellite observations. The program on coronal shocks forms part of the international Study of Travelling Interplanetary Phenomena, which is one of three main programs for the current Solar Maximum Year. Observations will also be made for another major SMY program, the Study of the Energy Release in Flares. In addition, cooperative programs will be carried out with various individual solar scientists.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Atmospheric Sciences

10.0014, PROPOSAL FOR THE INNOVATIVE RESEARCH PROGRAM
R.M. Walker, Washington University, School of Arts & Sciences, Dept. of Physics, *4559 Scott Ave., St. Louis, Missouri* 63130 (NAGW 122)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Office of Space Science

10.0015, CONTINUATION OF A COSMIC RAY RESEARCH PROGRAM USING A SUPERCONDUCTING MAGNET SPECTROMETER
R. Golden, New Mexico State University, Las Cruces Campus, School of Arts & Sciences, Dept. of Astronomy, *University Park, Las Cruces, New Mexico* 88003 (NAGW 110)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Office of Space Science

10.0016, RADAR INVESTIGATION OF ASTEROIDS
S.J. Ostro, Cornell University, Ithaca Campus, School of Arts & Sciences, Dept. of Astronomy, *Ithaca, New York* 14850 (NAGW 116)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Office of Space Science

10.0017, OBSERVATIONS OF THE LYMAN DISCONTINUITY IN LOW REDSHIFT CLOUDS
A.E. Glassgold, New York University, Washington Square & University College of Arts & Sciences, Dept. of Physics, *421 1st Ave., New York, New York* 10012 (NAG 5-122)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Goddard Space Flight Center

10.0018, SPECTRA OF DEGENERATE STARS OF KNOWN MASS
M.P. Savedoff, University of Rochester, School of Arts & Sciences, Dept. of Astronomy, *260 Crittenden Blvd., Rochester, New York* 14627 (NAG 5-123)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Goddard Space Flight Center

10.0019, HIGH ANGULAR RESOLUTION X-RAY AND X-RAY ULTRAVIOLET ASTRONOMY OBSERVATIONS
G.P. Garmire, Pennsylvania State University, University Park Campus, School of Science, Dept. of Astronomy, *211 Whitmore Lab., University Park, Pennsylvania* 16802 (NAG 5-100)

SUPPORTED BY U.S. National Aeronautics & Space Admin.,
Goddard Space Flight Center

10.0020, THEORETICAL AND OBSERVATIONAL INVESTIGATIONS OF WHITE DWARF ATMOSPHERES
S. Matsushima, Pennsylvania State University, University Park Campus, School of Science, Dept. of Astronomy, *211 Whitmore Lab., University Park, Pennsylvania* 16802 (AST80-02677)

This grant will involve a study of white dwarf stars that show carbon molecular bands in their spectra. Detailed spectroscopic observations of selected objects will be made and theoretical model atmosphere analyses will be used in carrying out the study. These white dwarf stars have never been studied systematically. Since they show carbon bands in their spectra, they present an opportunity for theoretical work on processes that determine the atmosphere abundances in white dwarf stars.

This study will (a) empirically obtain the atmosphere abundances of elements in the atmosphere of these stars and (b) theoretically compute grids of model atmosphere covering a wide range of effective temperatures and carbon abundances. The results could provide new information on the relative importance of convective mixing, gravitational setting, and accretion in the outer layers of white dwarf stars.

SUPPORTED BY U.S. National Science Foundation,
Directorate for Astronomical
Atmospheric Earth & Ocean Scis., Div.
of Astronomical Sciences

10.0021, RADIATION PROBLEMS IN GENERAL RELATIVITY
A.I. Janis, University of Pittsburgh, School of Arts & Sciences, Dept. of Physics & Astronomy, *4200 5th Ave., Pittsburgh, Pennsylvania* 15260 (PHY78-13926)

Theoretical physics research will be done in the area of general relativity. The following is a brief summary of the main topics to be emphasized. 1) There will be continued study of the geometric properties of the four-complex dimensional space (H-space) of asymptotically shear-free null surfaces in asymptotically flat space-times and its relationship to twistor theory. Particular points to be worked on are: a) To generalize the techniques to include Yang-Mills theory. b) To further explore the unusual theory of equations of motion (ponderomotive force laws) that seems to be emerging. c) To understand, more precisely, how to find the physical space which produced a given H-space. d) To find more explicit H-spaces. e) To study the wide class of two-dimensional real H-spaces. f) To generalize the Penrose twistor particle classification scheme to deformed twistor space. g) To study the use of hyperfunction theory and sheaf theory in the case of non-analytic solutions to field equations. 2) It is planned to study several aspects of angular momentum in general relativity. In particular these include the removal of the ambiguities in the definition of angular momentum and the difficult question of finding the relationship between the rotational motion of sources and the total angular momentum.

This work is a continuation of that currently supported under NSF grant PHY76-17253 AO1.

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

No abstracts in this category.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N81-16975*# *Analytical Methods, Inc., Bellevue, Wash.*
A THREE-DIMENSIONAL VISCOUS/POTENTIAL FLOW INTERACTION ANALYSIS METHOD FOR MULTI-ELEMENT *WINGS: MODIFICATIONS TO THE POTENTIAL FLOW* CODE TO ALLOW PART-SPAN, HIGH-LIFT DEVICES AND CLOSE-INTERFERENCE CALCULATIONS
B. Maskew Mar. 1979 143 p refs
(Contract NAS2-8788)
(NASA-CR-152277) Avail: NTIS HC A07/MF A01 CSCL 01A

The description of the modified code includes details of a doublet subpanel technique in which panels that are close to a velocity calculation point are replaced by a subpanel set. This treatment gives the effect of a higher panel density without increasing the number of unknowns. In particular, the technique removes the close approach problem of the earlier singularity model in which distortions occur in the detailed pressure calculation near panel corners. Removal of this problem allowed a complete wake relaxation and roll-up iterative procedure to be installed in the code. The geometry package developed for the new technique and also for the more general configurations is based on a multiple patch scheme. Each patch has a regular array of panels, but arbitrary relationships are allowed between neighboring panels at the edges of adjacent patches. This provides great versatility for treating general configurations. T.M.

N81-16976*# Scientific Research Associates, Inc., Glastonbury, Conn.
PREDICTION OF LAMINAR AND TURBULENT PRIMARY AND SECONDARY FLOWS IN STRONGLY CURVED DUCTS Final Report
J. P. Kreskovsky, W. R. Briley, and H. McDonald Washington NASA Feb. 1981 59 p refs
(Contract NAS3-22014)
(NASA-CR-3388; R80-900007-12) Avail: NTIS HC A04/MF A01 CSCL 01A

The analysis is based on a primary secondary velocity decomposition in a given coordinate system, and leads to approximate governing equations which correct an a priori inviscid solution for viscous effects, secondary flows, total pressure distortion, heat transfer, and internal flow blockage and losses. Solution of the correction equations is accomplished as an initial value problem in space using an implicit forward marching technique. The overall solution procedure requires significantly less computational effort than Navier-Stokes algorithms. The solution procedure is effective even with the extreme local mesh resolution which is necessary to solve near wall sublayer regions in turbulent flow calculations. Computed solutions for both laminar and turbulent flow compared very favorably with available analytical and experimental results. The overall method appears very promising as an economical procedure for making detailed predictions of viscous primary and secondary flows in highly curved passages. T.M.

N81-16977*# National Aeronautics and Space Administration. *Ames Research Center, Moffett Field, Calif.*
STEADY AND NONSTEADY SUPERSONIC TURBULENT AFTERBODY FLOW
Kenneth K. Yoshikawa and Alan A. Wray Feb. 1981 23 p refs
(NASA-TP-1769; A-8271) Avail: NTIS HC A02/MF A01 CSCL 01A

The effect of the specific heat ratio gamma of the incoming ideal gas on the flow properties, especially on pressure distributions along the base and sting surfaces and on reattachment distance, was investigated. The specific heat ratios considered were gamma = 1.2, 1.4, and 1.667. Also, effects of other major parameters, such as eddy-viscosity coefficient (or effective Reynolds number) and Mach number, on the afterbody pressure and reattachment distance were studied and are discussed. Evolution of shock induced flow and stabilization time were examined and are discussed for a transient problem. The important influence of the flow-field geometry, pressure distributions, and reattachment distance on the aerodynamics radiative heat transfer for an atmosphere entry probe in high speed flight are briefly described. T.M.

N81-16978# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
HYPERSONIC BOUNDARY LAYER TRANSITION EXPERIMENTS Final Report, Sep. 1976 - Sep. 1979
Kenneth F. Stetson Oct. 1980 85 p refs
(AF Proj. 2307)
(AD-A093819; AFWAL-TR-80-3062) Avail: NTIS HC A05/MF A01 CSCL 20/4

New hypersonic wind tunnel data have been obtained to investigate boundary layer transition with primary emphasis given to tip bluntness and angle of attack effects. The rearward displacement of transition on the cone frustum due to tip bluntness was found to be quite sensitive to free stream Mach number as well as the entropy layer swallowing by the boundary layer. At the highest Mach number obtained in these experiments (M = 9.3), the length of laminar flow could be extended to about nine times the length of laminar flow of a sharp cone at identical conditions. The sensitivity of the maximum rearward displacement of transition with free stream Mach number appeared to be primarily related to local Reynolds number reduction because

of pressure losses across the bow shock. Low transition Reynolds numbers typically found on nosetips, extended onto the front portion of the cone frustum. It appears that the still unexplained low transition Reynolds numbers associated with blunt bodies in hypersonic flow includes not only the nosetip region, but the forward portion of the cone frustum. Transition location was found to be sensitive to small changes in angle of attack, and both the sharp and blunt tips produced a rearward movement of transition on the windward ray at small angles of attack. A low supersonic flared nozzle closely duplicated the hypersonic pressure and heat transfer distributions over the nose region of a blunt body. GRA

N81-16979# Dynamics Technology, Inc., Torrance, Calif.
ANALYSIS FOR OBTAINING HIGH LIFT PRESSURE DISTRIBUTIONS FOR TRANSONIC AIRFOILS Final Technical Report
E. James and K. Kusunose Jun. 1980 111 p refs
(Contract N00014-79-C-0458; NR Proj. 212-263)
(AD-A093982; DT-7817-6) Avail: NTIS HC A06/MF A01 CSCL 01/3

This report describes the development of a method for obtaining an optimum pressure distribution over the suction side of an airfoil operating in the transonic speed regime. The pressure distribution is optimum in the sense that maximum lift on the airfoil section is desired while the flow over the airfoil remains fully attached. The development allows for shocked and shock free flows over the airfoil with a compressible and mixed laminar-turbulent boundary layer. The boundary layer is typically maintained on the verge of incipient separation over the rearward stretch of the airfoil. The pressure recovery distribution is obtained from a compressible extension of Stratford's incompressible turbulent boundary layer separation criterion which is also given in the report. A variational problem for maximum lift is formulated and solved to yield the location of the onset of the pressure recovery and the pressure distribution forward of this point. GRA

N81-16980# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
SKIN-FRICTION MEASUREMENTS AT SUBSONIC AND TRANSONIC MACH NUMBERS WITH EMBEDDED WIRE GAGES Final Report, Oct. 1978 - Mar. 1980
D. W. Sinclair AEDC Jan. 1981 47 p refs Sponsored by AF
(AD-A093722; AEDC-TR-80-29) Avail: NTIS
HC A03/MF A01 CSCL 14/2

Embedded wire skin friction gages were tested in the Acoustic Research Tunnel (ART) and on a model in Tunnel 16T at AEDC. The range of Mach numbers and Reynolds numbers considered was typical of the conditions encountered in transonic wind tunnel testing. Data obtained by the embedded wire technique agreed well with data from conventional methods of measuring skin friction when the gages were calibrated in situ. When the gages were calibrated and reinstalled at a later date, the calibration coefficients could not be corrected by simple techniques. GRA

N81-16981# *ARO, Inc., Arnold Air Force Station, Tenn.*
INTERFERENCE ON A MODEL AFTERBODY FROM DOWNSTREAM SUPPORT HARDWARE AT TRANSONIC *MACH NUMBERS Final Report, 27 Jun. - 2 Jul. 1979*
Earl A. Price, Jr. AEDC Jan. 1981 51 p refs Sponsored by AF
(AD-A093739; AEDC-TR-80-27) Avail: NTIS
HC A04/MF A01 CSCL 01/3

An experimental program was conducted to parametrically study the interference on an afterbody model that would be produced by the aft support blade used with a wingtip support system. Geometric variables included the blade axial location, thickness, span, chord, and leading and trailing edge contours. Data were obtained over the Mach number range from 0.6 to 1.2 with the model at zero angle of attack. Interference was evaluated by comparing afterbody drag from a reference configuration, which had the aft support blade removed, to the various configurations with a blade installed. A reasonable correlation of the blade interference effects on the afterbody drag coefficient was obtained, which included the influence of support blade axial position and blockage. Decreasing blade leading edge bluntness by a factor of two resulted in a significant reduction of interference in the Mach number range from 0.9 to 1.1. Significantly greater interference was measured without jet flow than with jet flow. It is shown that a Euler equation computer code is a useful tool for the design of minimum interference support systems. GRA

N81-16982# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF CRITICAL STING LENGTH ON A 7 DEG CONE AS DETERMINED BY MEASUREMENTS OF DYNAMIC STABILITY DERIVATIVES AND BASE PRESSURE FOR MACH NUMBERS 0.2 THROUGH 1.3 Final Report, 26 Sep. - 3 Oct. 1979
Fred B. Cyran, Bob L. Uselton, and Ed J. Marquart AEDC Jan. 1981 60 p refs
(AD-A093973; AEDC-TR-80-17) Avail: NTIS
HC A04/MF A01 CSCL 13/5

Wind tunnel tests were conducted to provide sting-support interference information for planning and directing wind tunnel tests at subsonic and transonic Mach numbers. Sting-length effects on dynamic stability derivatives, static pitching moment, and base pressure of a blunt, flat-base 7-deg cone were investigated at Mach numbers 0.2 to 1.3 in the Arnold Engineering Development Center (AEDC) Propulsion Wind Tunnel Facility (PWT). Two frequencies of oscillation, nominally 5.3 and 2.9 Hz, were investigated. The boundary-layer state at the model base was turbulent for all Mach numbers greater than 0.2. The interference effects of two types of model-wake splitter plates were also investigated. The results showed that the critical sting length depended on the Mach number, angle of attack, and type of data used as the interference indicator. A critical sting length depended on the Mach number, angle of attack, and type of data used as the interference indicator. A critical sting length of three model diameters was determined to be suitable for all test conditions for the ratio of sting-diameter-to-model-base-diameter (0.22) for this test. GRA

N81-16983# *Army Research and Technology Labs., Moffett Field, Calif. Aeromechanics Lab.*
VISCOUS-INVISCID INTERACTION ON OSCILLATING *AIRFOILS IN SUBSONIC FLOW*
W. J. McCroskey (NASA Ames) and S. L. Pucci 15 Jan. 1981 17 p refs Presented at the 19th AIAA Aerospace Sci. Meeting, St. Louis, 12-15 Jan. 1981
(AD-A093970; AIAA-81-0051) Avail: NTIS
HC A02/MF A01 CSCL 20/4

Selected results from an extensive oscillating airfoil experiment are analyzed and reviewed. Four distinct regimes of viscous-inviscid interaction are identified corresponding to varying degrees of unsteady flow separation. The dominant fluid dynamic phenomena are described for each regime. Ten specific test cases, including the appropriate flow conditions and experimental results, are proposed for evaluating unsteady viscous theories and computational methods. GRA

N81-16984# California Univ., Berkeley. Dept. of Mechanical Engineering.
***SUPERCRITICAL FLOW PAST SYMMETRICAL AIRFOILS* Ph.D. Thesis. Interim Report**
Kon-Ming Li Dec. 1980 50 p refs
(Grant AF-AFOSR-0230-80; AF Proj. 2307)
(AD-A093300; AFOSR-80-1357TR) Avail: NTIS
HC A03/MF A01 CSCL 20/4

A numerical method is developed for computing steady supercritical flow about an ellipse at zero angle to attack. The flow is assumed to be two dimensional, inviscid, isentropic, and irrotational. The free stream Mach number lies in the high subsonic range so that a shock wave occurs locally near the body. The full potential equations are solved by Telenin's Method and the Method of Lines. Smooth interpolating functions are assumed for the unknown flow variables in selected coordinate directions. The resulting set of ordinary differential equations is then integrated away from or along the body depending upon whether the flow is smooth or discontinuous. Jump conditions of the governing equations are applied across the shock wave so that it is perfectly sharp. A doublet solution for flow past a closed body is used as the far field boundary condition. Supercritical flow calculations have been performed for ellipses with thickness ratio of 0.2 and 0.4 at various free stream Mach numbers. The

present results are compared with the shock-capturing method, and good agreement is obtained. GRA

N81-16985# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).

SHOCK WAVES, HOW TO RECOGNIZE THEM, USE THEM, AND TO PROVIDE AGAINST THEM [LES ONDES DE CHOC, LES CONNAITRE, LES UTILISER, S'EN PREMUNIR]

C. Mas Paris 1979 11 p In FRENCH Presented at Congr. on Explosifs et Pyrotech. Appl. Spatiales, Toulouse, 22-25 Oct. 1979

(SNIAS-792-422-102) Avail: NTIS HC A02/MF A01

The use of one and two dimensional computer programs for detonation studies (wave propagation) is described. Experimental work encountered in the literature is presented together with the results of accelerometry measurements made to define shock spectra envelopes recorded on missile and missile launching structures. The way in which pyrotechnic shock effects on materials are predetermined is discussed. Mathematical modeling techniques and the appropriate calculations which enable the pyrotechnic forces to be understood and exploited are examined.

Author (ESA)

N81-16986# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

PROPULSIVE JET FLOW INTERFERENCE ON AFTERBODIES: SUMMARY AND CONCLUSIONS [TREIBSTRAHLINTERFERENZ BEI FLUGKOERPERN: ZUSAMMENFASSUNG UND ABSCHLUSS]

B. Wagner Bonn Bundesministerium fuer Verteidigung 1979 102 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteidigung

(BMVg-FBWT-79-26) Avail: NTIS HC A06/MF A01

All fundamentally important physical parameters are taken into account for calculating the supersonic flow about boattails containing a propulsive jet. The problem of backflow within the base region is discussed for the model case of a simple back step. The influence of the wall boundary layer on axisymmetric jet afterbody interference is determined through the concepts of equivalent bleed and origin shift, while the recompression process is described by an angular criterion. A modification of this criterion is introduced for the case of confluence of two shear layers. The Reynolds number influence on the base flow is estimated and proves to be relatively small within the usual Reynolds number range. The empirical relation of Zukoski is used for calculating the separation on conical afterbody surfaces. This relation was modified to account for incipient separation. For afterbodies at different angles of attack, the angle of attack effect on the inviscid outer flow field is calculated by applying a linearized characteristics method. Basic diagrams are included.

Author (ESA)

N81-16987# Messerschmidt-Boelkow G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.

A THEORETICAL METHOD FOR THE SIMULATION OF SEPARATION BEHAVIOR OF AIRCRAFT EXTERNAL STORES [EIN THEORETISCHES VERFAHREN ZUR SIMULATION DES ABGANGSVERHALTENS VON AUSSENLASTEN VOM TRAEGER]

R. Deslandes 26 Nov. 1979 16 p refs In GERMAN Presented at DGLR Wehrtech. Symp. on der Abgang von Lasten u. Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979 (MBB-FE-122/S/PUB/16; DGLR-79-091) Avail: NTIS HC A02/MF A01

A computer program which predicts store separation trajectories for fighter aircraft configurations is presented. The calculation method is based on finite elements and takes into account drag and other aerodynamic interference effects on stores. It includes a mathematical model of jettison (or launch/drop) forces and portrays store behavior as equations of motion with six degrees of freedom. Interference calculation results for a typical wing-fuselage stores configuration are compared with wind tunnel captive trajectory measurements and are shown to be satisfactory. Author (ESA)

N81-16988# Messerschmidt-Boelkow G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.

STORE SEPARATION SIMULATION IN SUBSONIC WIND TUNNELS [AUSSENLASTTECHNIKEN IN UNTERSCHALL-WINDKANAELEN]

R. Leistner 21 Nov. 1979 37 p refs In GERMAN Presented at DGLR Wehrtech. Symp. on der Abgang von Lasten u. Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979 (MBB-FE-123/S/PUB/20; DGLR-79-098) Avail: NTIS HC A03/MF A01

Wind tunnel simulation techniques for studying the ejection behavior and trajectories of fighter aircraft external stores are considered. The aerodynamics of a fixed store model in a subsonic flow are examined. The dynamic case of a free model is covered in detail. Scaling methods, particularly Froude scaling, are discussed. The construction and calibration of a dynamically similar model is described. The setup of a store separation wind tunnel study is outlined, emphasizing immediately necessary measurements as well as measurements which could be useful in aircraft design. Author (ESA)

N81-16989# Centre d'Essai Aeronautique, Toulouse (France).

UNSTEADY WAKES DOWNSTREAM FROM A PROFILE OSCILLATING IN INCIDENCE [SILLAGES INSTATIONNAIRES A L'AVAL D'UN PROFIL EN OSCILLATIONS D'INCIDENCE]

J. Coulomb and J. Verriere Paris Association Aeronautique et Astronautique de France 1980 33 p refs In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-10; ISBN-2-7170-0606-0) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Velocity profiles in a turbulent wake downstream from a wing model oscillating in incidence were determined by hot wire anemometry in a rectangular wind tunnel at a flow speed of 50 m/sec. A Fourier analysis of measurements was made. Results show a considerable modification of the velocity distribution in the wakes outside the quasistationary domain. Motion in the wake structure also perturbs the potential flow. It results that calculation of drag coefficients by the Betz method becomes uncertain. The evolution of velocity profiles in function of oscillating frequency is illustrated. Author (ESA)

N81-16990# Lille Univ. (France). Inst. de Mecanique des Fluides.

EXPERIMENTAL STUDY OF THE TRANSONIC FLOW IN AN AIR INTAKE AT HIGH ANGLE OF INCIDENCE [ETUDE EXPERIMENTALE D'ECOULEMENTS TRANSONIQUES DANS UNE PRISE D'AIR A GRANDE INCIDENCE]

A. Dyment, P. Gryson, and J. P. Flodrops Paris Association Aeronautique et Astronautique de France 1980 41 p refs In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-17; ISBN-2-7170-0613-3) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Some transonic flow properties in a two dimensional air intake at large angle of attack were determined. The internal flow regime showing two separations was observed in an intake model. The experiment was carried out in a transonic wind tunnel and with the model at an incidence of 40 deg to the flow axis. Results show that the addition of a slot as an auxiliary intake in the lower side of the intake model considerably improves the inlet performance. Placing a scoop over the slot intake is also shown to help in the homogenization of the internal flow.

Author (ESA)

N81-16991# Centre d'Essais Aeronautique Toulouse, Poitiers (France).

HIGHLY SEPARATED TRANSONIC FLOW [ECOULEMENTS TRANSONIQUES FORTEMENT DECOLLES]

A. Farcy, V. Mercier, R. Leblanc, and R. Goethals Paris Association Aeronautique et Astronautique de France 1980 22 p refs In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(Contract DRET-79-069)

(AAAF-NT-80-18; ISBN-2-7170-0614-1) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

A highly separated transonic flow was studied under laboratory conditions in order to show the usefulness of combining

various flow visualization and analysis techniques in defining jet engine intake flow characteristics. The experimental setup consisted of a section of rectangular tubing placed at an angle of incidence of 40 deg to a transonic jet. Measurements were obtained by filmed visualization, pressure sensors, laser anemometry, and hot wire anemometry. Results support a general description of the different flow parameters; i.e., the existence of shocks and their stability, the existence of a bubble at the lower leading edge of the air inlet, its dimensions and particularly the reattachment of its boundary, and flow rate coefficient approximated from pressure data. An attempt to describe flow turbulence is also made. Author (ESA)

N81-16992# Association Aeronautique et Astronautique de France, Paris.

EXAMINATION OF THE VORTEX REGIME FOR HIGHLY SWEPT WINGS BY EXTRAPOLATION OF THE JONES METHOD [ESSAI D'ETUDE DU REGIME TOURBILLONNAIRE DES AILES DE FORTE FLECHE PAR EXTRAPOLATION DE LA METHODE DE JONES]

R. Hirsch 1980 24 p In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-25; ISBN-2-7170-0621-4) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

The formation of vortex sheets along the surface of a separated flow over the leading edge of a sweptback wing is discussed. A phenomenological explanation based on representations and hypotheses from simplifying calculations inspired by Jones approximation is offered. Four conditions for fixing vortex sheet configurations and their intensity are defined. A correction algorithm for the Jones approximation is also given. Calculations were done on a HP-97 computer and are compred with various experimental measurements (delta wings, ducktail, strakes, etc.); results are satisfactory. Author (ESA)

N81-16993# Societe Nationale Industrielle Aerospatiale, Paris (France). Div. des Engins Tactiques.

AERODYNAMIC PROBLEMS WITH A MISSILE AT HIGH ANGLE OF ATTACK TO AN INCOMPRESSIBLE FLOW [PROBLEMES AERODYNAMIQUES D'UN MISSILE A GRANDE INCIDENCE EN INCOMPRESSIBLE]

M. Mesniere and G. Lacau Association Aeronautique et Astronautique de France 1980 24 p refs In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979

(AAAF-NT-80-27; ISBN-2-7170-0623-0) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

It is noted that for a missile launched vertically, very high angles of attack are encountered during the early part of the flight at low speed. These angles of attack are essentially due to gusts and rotation in pitch of the missile. A comprehensive wind tunnel study was completed. The longitudinal stability results are straightforward and in good agreement with the computed values. However, at high angles of attack, a nonstationary rolling movement becomes evident. This is due to vortices issuing near the ogive cylinder junction. Putting longitudinal strakes on the missile alleviates the problem. The longitudinal stability improvement is shown through subsequent measurements. Author (ESA)

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N81-16994*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE USE OF TOTAL SIMULATOR TRAINING IN TRANSITIONING AIR-CARRIER PILOTS: A FIELD EVALUATION

Robert J. Randle, Jr., Trieve A. Tanner, Joy A. Hamerman (Ford Aerospace and Communications Corp., Sunnyvale, Calif.), and Thomas H. Showalter (Stanford Univ., Calif.) Jan. 1981 99 p refs

(NASA-TM-81250; A-8411) Avail: NTIS HC A05/MF A01 CSCL 05I

A field study was conducted in which the performance of air carrier transitioning pilots who had landing training in a landing maneuver approved simulator was compared with the performance of pilots who had landing training in the aircraft. Forty-eight trainees transitioning to the B-727 aircraft and eighty-seven trainees transitioning to the DC-10 were included in the study. The study results in terms of both objectively measured performance indicants and observer and check-pilot ratings did not demonstrate a clear distinction between the two training groups. The results suggest that, for these highly skilled transitioning pilots, a separate training module in the aircraft may be of dubious value. T.M.

N81-16995# Dayton Univ., Ohio. Research Inst.

EVALUATION OF BIRD LOAD MODELS FOR DYNAMIC ANALYSIS OF AIRCRAFT TRANSPARENCIES Final Report, Jan. 1978 - Dec. 1979

Blaine S. West and Robert A. Brockman Aug. 1980 87 p refs

(Contract F33615-76-C-3103; AF Proj. 2202)

(AD-A092909; UDR-TR-80-59; AFWAL-TR-80-3092) Avail: NTIS HC A05/MF A01 CSCL 01/3

The objective of the program was to experimentally and analytically examine the range of applicability of existing bird loading models. The program consisted of two primary tasks; (1) the design of an experiment and the collection of experimental data for actual bird impact on a flexible target, and (2) the computation of the response to the experimental impact conditions using the MAGNA code and existing bird loading models. Projectiles made of bird simulant material were launched at specially designed aluminum targets at velocities in the range of 60 to 300 m/sec. Impacts were at angles of 90 (normal), 45, and 25 degrees for nominal bird weights of 77 and 560 grams. Time history of target out-of-plane surface displacement was measured for all impacts and strain gage data was collected for selected impacts. Calculated response data is compared to experimental data for selected impact conditions. It is demonstrated that good results can be obtained with an uncoupled loading model using a priori information to modify the loading model. GRA

N81-16996# Honeywell Systems and Research Center, Minneapolis, Minn.

TWO-AXIS, FLUIDICALLY CONTROLLED THRUST VECTOR CONTROL SYSTEM FOR AN EJECTION SEAT Final Report, 1 Apr. 1978 - 1 Oct. 1979

Robert B. Beale, Robert V. Burton, and Norman E. Miller Wright-Patterson AFB, Ohio AFWAL Jul. 1980 150 p refs

(Contract F33615-76-C-3070; AF Proj. 2402)

(AD-A093888; HONEYWELL-80SRC22; AFWAL-TR-80-3080) Avail: NTIS HC A07/MF A01 CSCL 01/3

A two-axis, hydrofluidic, thrust vector control (TVC) system was designed to stabilize an ejection seat during the critical rocket burn portion of the trajectory which should reduce the g loads on the crewmember and result in higher trajectories. The dynamic performance of a seat with a fluidic TVC system was analytically evaluated against established ejection seat requirements and physiological limits. This analysis showed that pitch rates were reduced by 60 percent and yaw rates by 90 percent when compared with a seat with no stabilizing system. Breadboard hardware was fabricated and tested with the components meeting requirements. A prototype integrated fluidic circuit and a moveable nozzle was then designed, fabricated and tested. The prototype system did not meet all the requirements due to a null bias instability in the fluidic amplifier which was caused by a nozzle asymmetry in the fluidic amplifier mold. The FTVC System included a vortex rate sensor, fluidic lag-lead compensator, and a four-stage fluidic servovalve. These components will use hot gas pressurized oil to drive a hydrostatically supported, piston actuated ball and socket nozzle with 20 deg of deflection of a 3500 lb thrust rocket. Initial nozzle breakaway friction was 170 in-lb. Operating friction was 135 in-lb and running friction was 80 in-lb. GRA

N81-16997# Simula, Inc., Tempe, Ariz.
AIRCRAFT CRASH SURVIVAL DESIGN GUIDE.
VOLUME 1: DESIGN CRITERIA AND CHECKLISTS, REVISION Final Report
S. P. Desjardins, D. H. Laananen, and G. T. Singley, III Dec. 1980 272 p refs
(Contract DAAJ02-77-C-0021; DA Proj. 1L1-62209-AH-79)
(AD-A093784; TR-7927; USARTL-TR-79-22A) Avail: NTIS HC A12/MF A01 CSCL 01/2

This five-volume document has been assembled to assist design engineers in understanding the problems associated with the development of crashworthy U. S. Army aircraft. Contained herein are not only a collection of available information and data pertinent to aircraft crashworthiness but suggested design conditions and criteria as well. The five volumes of the Aircraft Crash Survival Design Guide cover the following topics: Volume 1 - Design Criteria and Checklists; Volume 2 - Aircraft Crash Environment and Human Tolerance; Volume 3 - Aircraft Structural Crashworthiness; Volume 4 - Aircraft Seats, Restraints, Litters, and Padding; and Volume 5 - Aircraft Postcrash Survival. This volume contains concise criteria drawn from Volumes 2 - 5, supplemented by checklists intended to assist designers in implementation of the criteria. GRA

N81-16998# *Human Engineering Labs., Aberdeen Proving* Ground, Md.
AN INVESTIGATION OF THE FIVE POINT RESTRAINT *SYSTEM FOR AVIATORS Final Report*
William B. DeBellis Oct. 1980 29 p
(AD-A093085; HEL-TM-21-80) Avail: NTIS *HC A03/MF A01 CSCL 01/2*

This report investigated a purported restriction on aircrew leg movements due to the anchor point location of the five point restraint system in the Advanced Attack helicopter (AAH). The system was investigated with aviators wearing both body armor and survival vest. An adjustable AAH crew seat mock-up was used which contained production cushions with anti-torque pedals with toe brakes. Results showed that the current configuration would not restrict the leg motion of the pilot. However, the restraint system did interfere with the body armor and survival vest. This effect confounded the results. GRA

N81-16999# National Transportation Safety Board, Washington, D. C. Bureau of Technology.
LISTING OF ACCIDENTS/INCIDENTS BY AIRCRAFT MAKE
AND MODEL, UNITED STATES CIVIL AVIATION, 1978
5 Aug. 1980 210 p
(PB81-110280; NTSB-AMM-80-1) *Avail: NTIS*
HC A10/MF A01 CSCL 01B

Included are the file number, aircraft registration number, date and location of the accident, aircraft make and model and injury index for all 4,675 accidents/incidents occurring in this period. This publication is published annually. GRA

N81-17000# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AIRCREW SAFETY AND SURVIVABILITY (LIMITED TO COMBAT AIRCRAFT)
R. Auffret, ed. (Centre d'Essais en Vol, Bretigny-Air, France) Oct. 1980 162 p refs In ENGLISH and FRENCH Proc. of conf. held in Bodo, Norway, 20-23 May 1980
(AGARD-CP-286; ISBN-92-835-0279-5) *Avail: NTIS*
HC A08/MF A01

Protection against cold, emergency ejection accidents, survivability equipment, and crew performance during difficult missions are discussed. Recommendations include improvements to equipment to improve the chance of survival, the adoption of some standard method of evaluating anti-exposure suits and, not least, radiographic screening of the spine during training to, inter alia, exclude those with conditions incompatible with flight. For individual titles, see N81-17001 through N81-17021.

N81-17001# *School of Aerospace Medicine, Brooks AFB, Tex.*
PREDICTION OF IMMERSION HYPOTHERMIA IN MEN WEARING ANTI-EXPOSURE SUITS AND/OR USING LIFE *RAFTS*
Sarah A. Nunneley and Eugene H. Wissler (Texas Univ., Austin) *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 8 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

A computer model of human thermoregulation was developed in an effort to improve operational guidance while minimizing the need for further human experimentation. The model is subdivided into 15 cylindrical elements representing the head, thorax, abdomen, and limbs, which are coupled through the circulatory system. Within each element, radial layers simulate tissues with appropriate physical and physiological properties; time dependent temperatures are computed at 15 radial locations. Various garments can be simulated by adding layers. Validation of the model against several experimental studies involving water temperatures of 5 to 18 C and subjects who were nude, lightly clothed, or used ventile suits and/or life rafts is described. The model is used to produce preliminary graphs and tables for operational use. Other possible model applications include: (1) evaluation of new or modified protective ensembles; (2) development of tables showing minimal clothing compatible with given environmental conditions and duration of exposure; and (3) prediction of survival times for search and rescue operations. E.D.K.

N81-17002# Centre d'Essais en Vol, Bretigny-Air (France). *Laboratoire de Medecine Aerospatiale.*
METHODS USED IN MILITARY AERONAUTICS FOR EVALUATING ACCIDENTAL IMMERSION PROTECTIVE *EQUIPMENT [METHODE D'EVALUATION DES EQUIP-*MENTS DE PROTECTION CONTRE LES IMMERSIONS ACCIDENTELLES UTILISES EN AERONAUTIQUE MILITAIRE]
C. Boutelier *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1981 5 p refs In FRENCH (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Equipments for protection against immersion must possess a certain number of qualities: they must be sufficiently tight to assure good thermal protection both in the water and in the ambient cold air; they must be compatible with the wearing of other equipment; they must not inflict too important a thermal restraint on the crew nor restrain freedom of movement during flight; and they must have a certain resistance to wear and tear. Methods for evaluating such equipment rarely take into account all these factors and, with the exception of that concerning immersions of human subjects in water (ASCC Air STD 61/12, Nov. 1, 1978), they are not standardized. The evaluation methods used in France are described by defining the principle for interpreting results, particularly those concerning thermal protection, and the estimation of tolerance time as a function of water temperature. Transl. by A.R.H.

N81-17003# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
RADIO-TEMPERATURE TRANSDUCERS FOR MEASUREMENT OF THERMAL STRESS IN COLD WATER IMMERSION SUIT RESEARCH AND DEVELOPMENT
L. A. Kuehn *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 9 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

The skin temperature tab is glued to the skin at appropriate sites to measure localized skin or micro-clothing temperatures. This transducer contains a miniature radiofrequency near field transmitter circuit which emits a radio signal that varies with the temperature of a critical temperature sensitive element of the circuit. It is used in conjunction with a separate hand held radio receiver unit which decodes the emitted signal from the transducer and displays its temperature value in analogue or digital form. The evaluation and use of this wireless technology for studies of personnel immersion/cold weather protection is reviewed. Special reference is made to the appraisal of an immersion protection jacket known as the thermal immersion protection system (TIPS) jacket which has a buoyancy bladder for self righting flotation. Use of the aforementioned technology enabled the immersion protection period of this jacket in still 4 C water or turbulent 20 C water to be assessed at two hours before hypothermic danger to survival became of paramount concern. This jacket was found to be of use only for

protection of personnel in short term cold water environments, such as that of the man overboard situation. E.D.K.

N81-17004# Institute of Aviation Medicine, Farnborough (England).
LABORATORY STUDIES ON COOLING IN SINGLE SEAT DINGHIES
D. J. Anton *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 7 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Preliminary experiments failed to demonstrate any difference in cooling rates when expressed in terms of mean esophageal or mean rectal temperature. After the initial temperature rise, rectal temperature fell consistently below esophageal temperature and in two subjects failed to stabilize in the experimental runs where the inner coverall was omitted. This failure to stabilize rectal temperature occurred in the presence of normal esophageal temperatures and raises doubts as to the validity of rectal temperature as an indicant of deep body temperature under these experimental conditions. In view of the low rectal temperature recorded, no attempt has been made to derive a body temperature. Foot temperatures suggest that non-freezing cold injury should be expected in survivors who have a protected period at sea under similar environmental conditions and is a possibility after as short a period as four hours thirty minutes. No subject exhibited serious signs of hypothermia in either condition in exposures up to six hours. E.D.K.

N81-17005# Danish Defence Command, Copenhagen. Aeromedical Services.
CENTRAL REWARMING TECHNIQUE IN THE TREATMENT OF PROFOUND ACCIDENTAL HYPOTHERMIA
Knud Jessen *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 4 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Accidental hypothermia is an unintended decrease of the body core temperature due to heat loss to cold and in particular wet surroundings. During the treatment an after-drop in core temperature leading to a rewarming collapse and a development of hypopotassaemia must be avoided. Rapid, central rewarming is recommended as the treatment of choice. Among various modalities peritoneal dialysis was a very efficient method. It is a simple routine procedure in many hospitals, it has few contraindications and almost no complications. During transportation to the definitive treatment the patient should be kept cold as the developed hypothermia by itself protects against anoxic tissue damage as the oxygen consumption is decreased to 50% of normal at 30 C and to 20% of normal at 20 C. This is also the reason why normal criteria of death are not valid for patients suffering from profound accidental hypothermia. Author

N81-17006# Institute of Aviation Medicine, Oslo (Norway).
PRINCIPLES OF TEACHING WINTER SURVIVAL TO AIR CREW
H. T. Andersen *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 3 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

A training program is described which provides aircrews with principles of arctic survival. The problems of the lone fighter pilot having ejected successfully into mountainous terrain high above sea level are addressed. Mental preparedness as well as practical exercises are emphasized. Trends in the development and testing of personal flying equipment are discussed. R.C.T.

N81-17007# Army Research Inst. of Environmental Medicine, Natick, Mass. Military Ergonomics Div.
IMMERSION SURVIVAL: THE KEY FACTORS
Ralph F. Goldman *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 11 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Several factors significant to the sustenance of body temperature while submerged in cold water were investigated. Particular attention was given to examining man's ability to sustain elevated heat production through continued body motion. Results indicate that without adequate insulation, increasing heat production by body motion can increase heat loss to such an extent that there is actually a net loss of body heat; generally unclothed individuals with less than 40 kg of body weight per square meter of surface should remain as still as possible during immersion. It is further indicated that even with the best available protective clothing, tolerance is limited without auxiliary heating of the extremities during immersion in less than 12 C water. R.C.T.

N81-17008# Institute of Aviation Medicine, Farnborough (England).
SURVIVAL AFTER EJECTION, 1968 - 1979
D. J. Anton *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 4 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Several problems encountered in post ejection situations were examined. Particular attention was placed on identifying deficiencies in equipment and drills and determining the difference between pilot preference and laboratory theory as well as their effect on overall survivability. R.C.T.

N81-17009# Naval Safety Center, Norfolk, Va.
SELECTED AEROMEDICAL FACTORS IN US NAVY COMBAT-TYPE AIRCRAFT MISHAPS
Victoria M. Voge and Allan Miller *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 5 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Some of the major aeromedical problem areas in fighter/attack jet aircraft communities are outlined. The following are emphasized: the ejection sequence; flail injuries; helmet injuries, ejection survival rates; fatalities due to out of the seat envelope ejection; delay of ejection; drowning; and other injuries caused by the ejection sequence. Some of the proposed methods of resolving these problems are discussed. Helicopter combat type aircraft have similar problem areas involving escape from the aircraft and survival until rescue. Various needs are discussed relative to these areas, with possible methods of resolution. The most common psychophysiological factors reported in a 6 year period on mishaps occurring to 2 major combat type aircraft were reviewed, and general conclusions drawn. Two recognized aeromedical problem areas discussed are: (1) the Emergency Deployment Syndrome, where the mishap rate increases because of a general disregard for rules and regulations at a time of national crisis; and (2) increased susceptibility to disorientation secondary to the ingestion of quinine water. R.C.T.

N81-17010# North Atlantic Treaty Organization, Bodo (Norway).
SEAT PACK FOR FIGHTER AIRCRAFT OPERATING ON THE NATO NORTHERN FLANK
T. M. Arestol *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 3 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

The survival seatpack for fighter aircraft is discussed. The seatpack is suited for arctic survival in winter as well as in summer and can sustain life for weeks when used effectively. The kit contains signaling and protective equipment, survival tools, and rations. M.G.

N81-17011# Centre d'Essais en Vol, Bretigny-Air (France). Lab. de Medecine Aerospatiale.
ERGONOMETRIC STUDY OF EJECTION THROUGH A BREAKABLE CANOPY [ETUDE ERGONOMIQUE L'EJECTION A TRAVERS VERRIERE FRAGILISEE]
B. Vettes *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 9 p In FRENCH (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

In order to do away with the delay necessary for ejecting the canopy before seat separation in classic systems, tests of passage directly through the canopy have been conducted at the Brittany Flight Test Center's Aerospace Medicine Laboratory since 1962. Although it presents some risks such as acceleration, deterioration of equipment, and impact on the pilot, this method of evacuation can be seen as being of value for canopies whose

thickness does not exceed 9 mn. The systemization of a means for preliminary breakage can be considered. Some static and dynamic tests (between 0 and 600 kt) performed on Mirage F.1 and Delta 2000 dummies gave satisfactory results. However, the application of the system to aircraft with freely falling canopies involves a certain number of difficulties. Aerodynamic forces are such that some pieces of plexiglass fall back on the pilot, which creates important risks. To overcome these inconveniences, a number of breakage devices were tested. Those giving the greatest satisfaction involve a two cycle breaking. In the first cycle, a pyrotechnic decoupling of the dome above the pilot takes place; in the second cycle, the rest breaks away from the canopy just before the knees pass. Transl. by A.R.H.

N81-17012# Milan Univ. (Italy). Inst. of Neurosurgery.
NEUROTRAMATOLOGICAL ASPECTS IN EJECTED PILOTS
V. A. Sironi, P. M. Rampini, E. Guerrisi (Italian Air Force, Milan), and U. Vitale (Italian Air Force, Milan) *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 7 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

Neurological and neurosurgical aspects in injured jet pilots after ejection are considered. Observations were carried out on 108 military and civil jet pilots, that from 1958 to 1978 performed a total of 110 ejections (80 from R84, and G91 and 30 from F104). The injuries were classified into none, minor, major, and fatal. The analysis of results shows that 42.% had no injuries, 19% had minor injuries, 25.5% had major injuries, and 12.8% had fatal injuries. In 24 cases (21.8%) vertebral injuries were present: in 16 cases vertebral fractures (62.% in dorso-lumbar tract and 25% in dorsal tract), in 2 cases dislocations and in 10 cases sprains and strains. Neurological signs were present in 12 cases: spinal cord injuries in 5 cases, head trauma in 6 cases, and peripheral nerve injuries in 3 cases. The importance of the correct diagnosis and treatment, the follow-up of these cases in relation to the pathogenetic mechanisms and the prevention of the permanent neurological deficits are presented and discussed. M.G.

N81-17013# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TRAUMATIC LESIONS OF THE CERVICAL SPINE 1971 - 1979: INCIDENCE-SEVERITY AND CLASSIFICATION
Leon E. Kaxzarian, William F. Belk (Air Force Inspection and Safety Center, Norton AFB, Calif.), and Harry P. Hoffman (Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 13 p refs (For primary document see N81-17000 08-03)
(AMRL-TR-80-53) Avail: NTIS HC A01/MF A01

The biodynamic pathogentic mechanisms of cervical spinal trauma associated with the open ejection seat are analyzed through a retrospective investigation. A change appears to have occurred in the frequency of severe neck injury over the eight years. Specifically the incidence of indirect neck injuries associated with fatality have increased. It was found that the type and mechanics of injuries to the upper cervical spine are much different when compared to injuries seen in the lower cervical spine. Injuries to the upper cervical spine seem to be related more frequently to fatalities, where injuries to the lower cervical spine result in major trauma and in a single case quadraplegia. A standardized classification system is proposed based on anatomical criteria discussed in radiographs of the head and neck. A classification scheme that considers the primary injury site and direction of the applied load is discussed. The injury types observed in this limited population are discussed. It is clear that the primary loading factors (inertial or aerodynamic) responsible for the aforementioned cervical injuries are the results of head loads that produce bending or twisting of the neck relative to the torso. M.G.

N81-17014# Naval Air Test Center, Patuxent River, Md.
AN OPINION FOR ENHANCED AIRCREW SURVIVABILITY
Harv Gregoire *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 6 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

The capabilities of ram-air parachute canopies in comparison to present canopy designs used in emergency egress systems are discussed. An estimate of potential ram-air parachute advantages in reducing injuries, fatalities, and capture within the limitations of southeast Asia combat escape experience is documented. Experiments in training requirements and recent developments in ram-air parachute reliability are described as applicable to utilization in present inventory combat aircraft. The enhancement of noncombat as well as combat survivability from a medical perspective is discussed, particulary as involves trauma and drowning during the parachute landing phase of an in-flight egress occurence. M.G.

N81-17015# Department of the Air Force, Wright-Patterson AFB, Ohio. Life Support System Program Office.
A SURVIVAL AVIONICS SYSTEM FOR THE 1980'S
D. E. Root and F. W. AHearn *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 2 p (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

A survival avionics system (SAS) is described that combines airborne avionics with an advanced survival radio and transponder, in a system designed to overcome past deficiencies. Derived from technology proven in the U.S. space program, SAS provides the search and rescue aircraft with precise range and direction data on up to six downed survivors simultaneously. The system is covert and operates over ranges up to 100 nautical miles. R.C.T.

N81-17016# Institute of Aviation Medicine, Farnborough (England).
THE EVOLUTION OF THE HELICOPTER SEAT PAN MOUNTED PERSONAL SURVIVAL PACK (PSP)
A. Steele-Perkins *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 3 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

A seat pan mounted personal survival pack of glass reinforced fiber construction was developed for use in all military helicopters. This offers much improved crashworthiness and increased comfort. These improvements are discussed, as well as the evolution of the survival pack through experience and application of ergonomics. R.C.T.

N81-17017# Army Aviation Research and Development Command, Fort Eustis, Va. Applied Technology Lab.
TEST AND EVALUATION OF IMPROVED AIRCREW RESTRAINT SYSTEMS FOR COMBAT HELICOPERS
George T. Singley, III *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 16 p refs (For primary document see N81-17000 08-03)
Avail: NTIS HC A08/MF A01

US Army aviation accident data shows that a majority of all injuries in attack helicopters could have been avoided if these aircraft had been equipped with crashworthy seat and restraint systems. The compactness of the cockpit and the close proximity of mission equipment to the crew in attack and scout helicopters pose serious crash impact hazards. Although not desirable from a crashworthiness standpoint, operational considerations may dictate that mission equipment and structure be located within the occupant's crash impact motion envelope. Given this situation, it is critical to the occupant's crach impact survival chances that he be provided with a restraint system that minimizes his crash impact motion envelope, particularly for his head. The cockpit can be delethalized further when the improved restraint is complemented by padding potential strike surfaces in the cockpit, making contact surface frangible, and providing weapon system sights with frangibility, telescoping, and/or swing-away features. T.M.

N81-17018# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
INFLUENCE OF THE WORKLOAD OF FLIGHT MISSIONS ON THE PERFORMANCE OF THE VISUAL SYSTEM OF AIRCREW
D. Harms, E. Pachale, R. Habersetzer, and G. Koehler *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 6 p refs (For primary document see N81-17000 08-03)

Avail: NTIS HC A08/MF A01

The importance of saccades (rapid eye movements from one target to another) for perception of visual environment and measure of mental fatigue is demonstrated. Pilots and aircrews' latencies of saccadic eye movements were measured with the EOG-technique pre and post-flight. F-104G pilots showed a significant increase in latencies after air-to-air gunnery training missions. Anti-tank helicopter crews showed a different but overall-remarkable increase in reaction time in the evening after a full day's job combined with restricted sleep. This effect cumulated from day to day and was completely abolished after a full night of undisturbed sleep. F-4F crews showed only an insignificant prolongation of saccadic latencies after air-to-air or air-to-ground missions. The results are discussed and compared with pertinent literature. T.M.

N81-17019# Institute of Aviation Medicine, Manching (West Germany).

TO THE FUNDAMENTALS OF THE ISOMETRIC MUSCLE TRAINING AS A PHYSICAL COUNTERACTION OF THE JET PILOT AGAINTS G-LOADS

A. Rieck *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1981 6 p (For primary document see N81-17000 08-03)

Avail: NTIS HC A08/MF A01

In spite of technical aids (anti-g-suit) increasing physical demands are made on the g-strength of the jet combat pilot as a result of the continuous advancement of aircraft. During g-loads this requires in addition to special breathing techniques the ability to contract certain muscle regions rapidly and effectively and to maintain this isometric tension for a certain period of time as strong as possible. Using an ELAG dynamometer the flexor and extensor muscle groups of the forearm as well as the extensor groups of the lower leg were trained in a defined sitting posture. The duration of the maximum arbitrary tension during the training phase was 6 sec each time and in the control phase 1 sec, while the interval between the onset of contractions was 1 minute. The number of contractions was varied for the different experimental set-ups. The recordings were continuously made using a line recorder. For the evaluation the maximum strength achieved was used. T.M.

N81-17020# Army Aeromedical Research Lab., Fort Rucker, Ala.

AVIATOR PERFORMANCE IN WEEK-LONG EXTENDED FLIGHT OPERATIONS IN A HELICOPTER SIMULATOR

Gerald P. Krueger, Richard N. Armstrong, and Ronald R. Cisco *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 14 p refs (For primary document see N81-17000 08-03)

Avail: NTIS HC A08/MF A01

Three 2 man crews of rotary wing aviators performed 14 hours of precision instrument flight in a simulator on each of five successive work days. Missions included repetitions of routine 2 hour standardized day and night instrument flight profiles which were occasionally interrupted by simulated flight emergency situations. Aviator flight performance was measured. Parameters assessed included: meeting airspeed, altitude, headings, turn rates, navigation ability, etc. In addition, measures of fatigue, stress and bodily state were collected throughout the study. These latter measures included physiological (cardiovascular monitoring and body temperature), psychological (behavioral, short term memory, oculomotor performance and subjective ratings), and biochemical (urine and isoprene) parameters. When not flying, pilots participated in laboratory tests of pursuit rotary tracking skill and visual search strategies. They were also examined by flight surgeons daily. The pilots ate three regularly scheduled meals and slept approximately four hours each night. Baseline data were collected prior to, and recovery data after the extended flight schedule. T.M.

N81-17021# British Aerospace Aircraft Group, Preston (England).

HUMAN FACTORS IN HIGH PERFORMANCE AIRCRAFT OPERATING IN DESERT AREA

M. F. Haskins *In* AGARD Aircrew Safety and Survivability (Ltd. to Combat Aircraft) Oct. 1980 4 p (For primary document see N81-17000 08-03)

Avail: NTIS HC A08/MF A01

A desert is defined as an area with a mean annual rainfall of less than 10 inches. The factors discussed are typical of a Middle Eastern desert with winter mean daily maximum temperatures of about 21 C but summer figures of about 43 C. The physiological responses to heat by aircraft pilots was examined. Pilot visibility over desert terrain was investigated. During sand storms it was found that pilots are likely to commit themselves to visual flight with consequent loss of orientation. The desert terrain was found to produce an empty visual field, similar to that of flying over the sea. T.M.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also 17 Spacecraft Communications, Command, and Tracking and 32 Communications.

N81-17022*# Lockheed-Georgia Co., Mariette.

STUDY OF GUIDANCE TECHNIQUES FOR AERIAL APPLICATION OF AGRICULTURAL COMPOUNDS

J. D. Caldwell, P. B. A. Dimmock, and R. H. Watkins Mar. 1980 71 p refs

(Contract NAS1-15575)

(NASA-CR-163268; ; LG-80ER0065) Avail: NTIS HC A04/MF A01 CSCL 17G

Candidate systems were identified for evaluation of suitability in meeting specified accuracy requirements for a swath guidance system in an agriculture aircraft. Further examination reduced the list of potential candidates to a single category, i.e., transponder type systems, for detailed evaluation. Within this category three systems were found which met the basic accuracy requirements of the work statement. The Flying Flagman, the Electronic Flagging and the Raydist Director System. In addition to evaluating the systems against the specified requirements, each system was compared with the other two systems on a relative basis. The conclusions supported by the analyses show the Flying Flagman system to be the most suitable system currently available to meet the requirements. A.R.H.

N81-17023# Lincoln Lab., Mass. Inst. of Tech., Lexington.

THE DABS DATA LINK AIRBORNE INTELLIGENT DISPLAY OPERATORS MANUAL

J. C. Anderson and J. L. Leeper 1 Sep. 1980 28 p

(Contract DOT-FA72WAI-261)

(AD-A092993; ATC-100; FAA-RD-80-106) Avail: NTIS HC A03/MF A01 CSCL 01/2

The Federal Aviation Administration is currently evaluating the Discrete Address Beacon System (DABS) which will provide increased air traffic safety in current and future air traffic conditions. In addition to improved surveillance accuracy and reliability, DABS provides a two-way data link between the DABS sensor and all DABS transponder equipped aircraft in view. A DABS data link avionics system, called the Airborne Intelligent Display (AID), was developed by M.I.T. Lincoln Laboratory for the purpose of evaluating and demonstrating initial and future data link applications. The microprocessor-based AID system communicates with the DABS ground sensor through the DABS transponder onboard the aircraft. Data link information included in uplink interrogations to the transponder is decoded in the airborne microprocessor and then made available to the pilot on a high visibility cathode ray tube display. GRA

N81-17024# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

MICROWAVE LANDING SYSTEM (MLS) CLEARANCE FORMAT ASSESSMENT TESTS Data Report, Jan. - Feb. 1980

Robert McFadden Dec. 1980 55 p

(AD-A093553; FAA-CT-80-46) Avail: NTIS HC A04/MF A01 CSCL 17/7

The purpose of this experiment was to provide static and

flight test data with the proposed Microwave Landing System (MLS) clearance format to support the MLS International Standards and Recommended Practices (SARPS) development by the International Civil Aviation Organization (ICAO) working group. GRA

N81-17025# IIT Research Inst., Annapolis, Md.
ANALYTIC DETERMINATION OF INTERFERENCE THRESHOLDS FOR MICROWAVE LANDING SYSTEM EQUIPMENT AND TACAN/DME EQUIPMENT Interim Report
Ved P. Nanda Aug. 1980 150 p refs
(Contracts F19628-78-C-0006; DOT-FA76WAI-612)
(AD-A093448; ECAC-PR-80-008; FAA-RD-80-89) Avail: NTIS HC A07/MF A01 CSCL 17/7

This report analytically estimates the interference thresholds of the Time Reference Scanning Beam (TRSB) Microwave Landing System (MLS) which is comprised of the C-Band angle guidance and the L-Band PDME range guidance equipments. Furthermore, interference thresholds and separation distance requirements of the coexisting TACAN/DME L-Band equipment are determined. GRA

N81-17026# IIT Research Inst., Annapolis, Md.
MLS CHANNEL ASSIGNMENT MODEL Interim Report
Thomas Hensler and Andrew Koshar Aug. 1980 108 p refs
(Contracts F19628-78-C-0006; DOT-FA76WAI-612)
(AD-A093449; ECAC-PR-80-012; FAA-RD-80-91) Avail: NTIS HC A06/MF A01 CSCL 17/7

An automated channel assignment model was constructed in response to an FAA need to assess the assignment feasibility of planned MLS angle-guidance equipment in C-band, and its associate L-band Precision Distance Measurement Equipment (PDME). The intersite interference analysis and channel-assignment algorithm capabilities are described. A trial assignment of MLS equipments was performed for a Southwest United States airport environment and the results are summarized. GRA

N81-17027# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C. Electronic Navigation Div.
DMAHTC'S SUPPORT TO NATIONAL OCEAN SURVEY LORAN-C CHARTING
John J. Speight and Edwin O. Danford Dec. 1980 41 p Presented at the 8th Natl. Ocean Survey Hydrographic Survey Conf.
(AD-A093748) Avail: NTIS HC A03/MF A01 CSCL 17/7

The selection of LORAN-C as the primary Radionavigation System for the U.S. Coastal Confluence Zone requires by, joint agreement, that DMAHTC, USCG, and NOS provide corrections to LORAN-C Lattices overprinted on NOS Charts. This paper reviews the techniques used to compute these corrections. It also gives the status of the LORAN-C System. GRA

N81-17028# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C. Electronic Navigation Div.
PRODUCTION OF LORAN-C RELIABILITY DIAGRAMS AT THE DEFENSE MAPPING AGENCY
Clarence L. Worrell 20 Nov. 1980 11 p refs Presented at the Inst. of Navigation Natl. Marine Meeting, New Orleans
(AD-A093749) Avail: NTIS HC A02/MF A01 CSCL 17/7

LORAN-C reliability diagrams depict two types of data, the maximum usable groundwave signal limit, which aids the LORAN-C user in determining which transmitters provide coverage in his area of operation, and the predicted uncertainty of a LORAN-C hyperbolic fix. Signal limits are computed using Bremmer's field prediction formula and an algorithm that predicts the range for a signal of predetermined signal-to-noise ratio propagating along an electrically inhomogeneous transmission path. Fix uncertainty predictions are based on a formula relating fix uncertainty to crossing angle between lines of position, system standard deviation, and the divergence of hyperbolic lines of position. Actual range and fix uncertainty may differ from values shown on reliability diagrams, depending on such factors as weather, the occurrence of geomagnetic disturbances, and the user's direction of travel. Reliability diagrams currently produced show signal limits and fix uncertainties for LORAN-C chains at a scale of 1:5,000,000; a new generation of reliability diagrams could show data at a reduced scale (1:10,000,000) for each LORAN-C triad (one master and two slave transmitters), making more chain and transmitter selection information available to the user. GRA

N81-17029# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.
HYDROGRAPHIC APPLICATIONS OF THE GLOBAL POSITIONING SYSTEM
Penny D. Dunn and John W. Rees, II Dec. 1980 8 p refs Presented at the 8th Natl. Ocean Survey Hydrographic Survey Conf. Prepared in cooperation with Naval Oceanographic Office, Bay St. Louis, Miss.
(AD-A093750) Avail: NTIS HC A02/MF A01 CSCL 17/7

Global Positioning satellites have been tested under a variety of conditions and demonstrated exceptional accuracy. The most portable of the Phase 1 development equipment is the manpack/vehicle user equipment (MVUE of manpack). The purpose of this study was to determine if a manpack is suitably accurate for large scale coastal hydrographic surveying. The manpack was placed aboard in the Naval Postgraduate School Research Vessel, R/V ACANIA. This objective required the testing of the manpack under varying survey conditions to determine the degradation of positional accuracy. The limit of the survey scale to which the unprocessed manpack data could be employed in a real-time operation was found to be 1:80,000 and smaller by the positioning error criteria of 0.5mm to the scale of the survey. Applications of differential techniques during the post-processing of the manpack position data increased the limit of the survey scale to 1:60,000 using the same position criteria. GRA

N81-17030# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.
FEDERAL RADIONAVIGATION PLAN. VOLUME 1: RADIONAVIGATION PLANS AND POLICY Final Report, Dec. 1979 - Jun. 1980
Jul. 1980 90 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.
(AD-A093774; DOT-TSC-RSPA-80-16-Vol-1; DOD-4650.4-P-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

The Federal Radionavigation Plan (FRP) has been jointly developed by the U.S. Departments of Defense and Transportation to ensure efficient use of resources and full protection of National interests. The plan sets forth the Federal interagency approach to the implementation and operation of radionavigation systems. The Federal Radionavigation Plan delineates policies and plans for Government-provided radionavigation services. The document describes respective areas of authority and responsibility, and provides a management structure by which the individual operating agencies will define requirements and meet them in a cost-effective manner. It replaces the DOT National Plan for Navigation, and those sections of the DOD Joint Chiefs of Staff (JCS) Master Navigation Plan dealing with common user systems. Volume 1 is a summary document which delineates plans, policies, and authority and responsibility for providing radionavigation services. An integrated management plan describing how DOT and DOD will determine requirements and coordinate research, development, and implementation of radionavigation systems is provided. GRA

N81-17031# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.
FEDERAL RADIONAVIGATION PLAN. VOLUME 2: REQUIREMENTS Final Report, Dec. 1979 - Jun. 1980
Jul. 1980 50 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.
(AD-A093775; DOT-TSC-RSPA-80-16-Vol-2; DOD-4650.4-P-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 17/7

The user requirements and the processes that were used to determine them are described. Both general and specific requirements related to various applications and phases of navigation are discussed. Present and future anticipated needs are also discussed. The requirements of civil and military users defined for radio navigational services are based upon the technical

and operational performance needed for military missions, transportation safety, and economic efficiency. T.M.

N81-17032# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.

FEDERAL RADIONAVIGATION PLAN. VOLUME 3: RADIONAVIGATION SYSTEM CHARACTERISTICS Final Report, Dec. 1979 - Jun. 1980

Jul. 1980 46 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.

(AD-A093776; DOT-TSC-RSPA-80-16-Vol-3; DOD-4650.4-P-Vol-3) Avail: NTIS HC A03/MF A01 CSCL 17/7

Present and planned navigation systems are described in terms of nine major parameters: signal characteristics, accuracy, availability, coverage, reliability, fix rate, fix dimensions, capacity, and ambiguity. The characteristics, capabilities, and limitations of existing and proposed major radio navigation systems are discussed. All of the systems considered are defined in terms of system performance parameters which determine the utilization and limitations of the individual systems. T.M.

N81-17033# Department of Transportation, Washington, D. C. Office of Assistant Secretary for Systems Development and Technology.

FEDERAL RADIONAVIGATION PLAN. VOLUME 4: RADIONAVIGATION RESEARCH, ENGINEERING AND DEVELOPMENT Final Report, Dec. 1979 - Jun. 1980

Jul. 1980 120 p Prepared in cooperation with DOD, Washington, D.C. 4 Vol.

(AD-A093777; DOT-TSC-RSPA-80-16-Vol-4; DOD-4650.4-P-Vol-4) Avail: NTIS HC A06/MF A01 CSCL 17/7

The federal radio navigation R,E&D plan together with individual R,E&D plans for military and civil air, land, marine applications are summarized. Open issues and the means for their resolution are discussed. A key feature is a discussion on how the individual agency R,E&D plans will be coordinated to help assure that all aspects of each system are thoroughly evaluated while avoiding duplication of activitites. T.M.

N81-17034# General Dynamics Corp., San Diego, Calif. Electronics Div.

SELF-REFERENCING GUIDANCE INTERFEROMETER Final Report

G. Tricoles, R. A. Hayward, and E. L. Rope Jun. 1980 52 p refs

(Contract N00019-79-C-0637)

(AD-A093651; R-80-029-F) Avail: NTIS HC A04/MF A01 CSCL 17/7

This paper describes the concept of a Self-Referencing Interferometer. The term self-referencing interferometer describes a finite dielectric slab with sensors such as dipole antennas connected to detectors. More general structures are possible. For example, the dielectric can be a hollow shell, and the sensors might be antennas. However, flat dielectrics emphasize the physical basis. The essence of this interferometer is that an incident wave excites two coherent waves that have distinct propagation constants. GRA

N81-17035# Federal Aviation Administration, Atlantic City, N.J. Technical Center.

OMEGA TRANSMITTER OUTAGES, JANUARY TO DECEMBER 1979

Lorraine Rzonca Oct. 1980 18 p

(FAA Proj. 043-311-520)

(AD-A093425; FAA-CT-80-196; FAA-RD-80-113) Avail: NTIS HC A02/MF A01 CSCL 17/7

An investigation of Omega transmitter outages during 1979 was conducted with emphasis on the occurrence of simultaneous downtimes. Data presented includes frequency and duration of outages and total yearly percentage shutdown for each transmitter, with scheduled outages specifically noted. The most significant dual outage lasted more than 5 days when Norway antenna repairs were coincident with Argentina annual maintenance.GRA

N81-17036# Federal Aviation Administration, Atlantic City, N.J.

DETECTION OF MILITARY AIRCRAFT IN AN AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS) ENVIRONMENT Final Report, period ending Jun. 1980

Carl Hazelwood Dec. 1980 28 p refs

(AD-A093427; FAA-CT-80-37) Avail: NTIS HC A03/MF A01 CSCL 17/7

An initial survey and analysis of military Air Traffic Control Radar Beacon System (ATCRBS) transponder problems was conducted as a result of transponder performance analyzer (TPA) measurement difficulties encountered at Dobbins Air Force Base, Georgia, and from field problem reports from the Atlanta Terminal, New York and Washington Centers, and other areas. The information assembled and presented in this report demonstrates potential ATCRBS problems with high performance military aircraft in fringe areas of coverage and particularly with the Automated Radar Terminal Systems (ART's). Aircraft antenna patterns and switching are of primary concern. GRA

N81-17037# National Technical Information Service, Springfield, Va.

AIR TRAFFIC CONTROL SIMULATION MODELS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Sep. 1980

Guy E. Habercom, Jr. Oct. 1980 208 p Supersedes NTIS/PS-79/0799; NTIS/PS-78/0788

(PB81-800104; NTIS/PS-79/0799; NTIS/PS-78/0788) Avail: NTIS HC $30.00/MF $30.00 CSCL 17G

Enroute and terminal air traffic control facilities are investigated by use of mathematical models and computerized simulations. Ground based and satellite navigational aids are modeled for present and predicted air traffic requirements. Worldwide networks for traffic scheduling are simulated. This updated bibliography contains 203 citations, 34 of which are new entries to the previous edition. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics.

N81-17038*# Kansas Univ. Center for Research, Inc., Lawrence.

THE DAST-1 REMOTELY PILOTED RESEARCH VEHICLE DEVELOPMENT AND INITIAL FLIGHT TESTING Final Report

Alexandros Kotsabasis Feb. 1981 229 p refs

(Grant NsG-4017)

(NASA-CR-163105) Avail: NTIS HC A11/MF A01 CSCL 01C

The development and initial flight testing of the DAST (drones for aerodynamic and structural testing) remotely piloted research vehicle, fitted with the first aeroelastic research wing ARW-I are presented. The ARW-I is a swept supercritical wing, designed to exhibit flutter within the vehicle's flight envelope. An active flutter suppression system (FSS) designed to increase the ARW-I flutter boundary speed by 20 percent is described. The development of the FSS was based on prediction techniques of structural and unsteady aerodynamic characteristics. A description of the supporting ground facilities and aircraft systems involved in the remotely piloted research vehicle (RPRV) flight test technique is given. The design, specification, and testing of the remotely augmented vehicle system are presented. A summary of the preflight and flight test procedures associated with the RPRV operation is given. An evaluation of the blue streak test flight and the first and second ARW-I test flights is presented. R.C.T.

N81-17039*# Rensselaer Polytechnic Inst., Troy, N. Y. School of Engineering.

COMPOSITE STRUCTURAL MATERIALS Semiannual Progress Report, May - Sep. 1980

George S. Ansell, Robert G. Loewy, and Stephen E. Wiberley Jan. 1981 214 p refs

(Grant NGL-33-018-003)

(NASA-CR-163946; SAPR-39) Avail: NTIS HC A10/MF A01 CSCL 11D

The development of composite materials for aircraft applications is addressed with specific consideration of physical properties, structural concepts and analysis, manufacturing, reliability, and life prediction. The design and flight testing of composite ultralight gliders is documented. Advances in computer aided design and methods for nondestructive testing are also discussed. M.G.

N81-17040# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

AGARD FLIGHT TEST INSTRUMENTATION SERIES. VOLUME 10 ON HELICOPTER FLIGHT TEST INSTRUMENTATION

K. R. Ferrell (Army Aviation Research and Development Command, Edwards AFB, Calif.), A. Pool, ed., and K. C. Sanderson, ed. Jul. 1980 63 p refs
(AGARD-AG-160-Vol-10; AGARDograph-160-Vol-10; ISBN-92-835-1367-3) Avail: NTIS HC A04/MF A01

The helicopter characteristics with which the instrumentation must contend is discussed and the typical tests that are conducted are outlined. Major aircraft components and systems which may be instrumented are listed and suggestions are made for sensors, locations, and installation. Details are provided for instruments peculiar to helicopters. Interface of the test instrumentation with data recording systems and ground support facilities were also considered. A summary of instrumentation requirements is provided along with recommended range, accuracy, and resolution. A sample instrumentation management technique is also included. T.M.

N81-17041# *Naval Aerospace Medical Research Lab., Pensacola, Fla.*

ENERGY MANEUVERABILITY DISPLAY FOR THE AIR COMBAT MANEUVERING RANGE/TACTICAL TRAINING SYSTEM (ACMR/TACTS) Final Report

V. R. Pruitt, W. F. Moroney, and C. Lau Aug. 1980 69 p refs
(AD-A092974; NAMRL-SR-80-4) Avail: NTIS HC A04/MF A01 CSCL 01/2

This report describes the development of an integrated analog display (turn rate vs calibrated airspeed) for use as a debriefing aid on the Air Combat Maneuvering Range (ACMR). The ACMR gathers in-flight data from aircraft while they are engaged in air combat maneuvering. Upon returning from the ACMR, aircrew are presented with (1) a pictorial display of the engagement, and (2) a digital printout of selected encounter parameters (e.g., velocity 'g', altitude of each aircraft, range between aircraft). The display integrates these relevant energy maneuverability data into an analog format, thus providing an immediate comparison of the performance of each aircraft with respect to the maneuvering envelope of that aircraft and that of the opponent. The display also allows the aircrew to recognize very rapidly whether they are gaining or loosing energy and the rate of gain or loss. The maneuvering envelopes of the F-14, F-4, A-4 and F-5 aircraft can be displayed in this dynamic format. It is expected that this new format (1) will provide a better means for pilots to determine how well they have maximized the performance of their aircraft, and (2) may serve as an aid in tactics development. A brief discussion of the nature of energy maneuverability is contained in an Appendix. GRA

N81-17042# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

ZDRAFT-A GRAPHITE CODE FOR VTOL AIRCRAFT GROUND FOOTPRINT VISUALIZATION Final Report, Oct. 1978 - Jan. 1980

J. J. Zanine and K. A. Green Jan. 1980 115 p refs Sponsored by the Navy Dept.
(AD-A093311; NADC-80109-60) Avail: NTIS HC A06/MF A01 CSCL 01/3

The computer program, entitled 'ZDRAFT,' generates a graphic display of VTOL aircraft and their associated ground flow fields. The actual flow field data is calculated by another computer program. The 'ZDRAFT' computer code rapidly assimilates and displays this flow field data. The display consists of pertinent flow field characteristics, such as stagnation lines, upwash flow and ground plane wall jet conditions, superimposed over a scaled aircraft planform. This visual form allows easy assessment of various configurations and operating conditions. GRA

N81-17043# National Aeronautical Establishment, Ottawa (Ontario).

A METHOD FOR THE PREDICTION OF WING RESPONSE TO NONSTATIONARY BUFFET LOADS

B. H. K. Lee Jul. 1980 74 p In ENGLISH; FRENCH summary
(AD-A093037; NAE-LR-601; NRC-18629) Avail: NTIS HC A04/MF A01 CSCL 01/3

A method for the prediction of the response of a wing to nonstationary buffet loads is presented. The time history of the applied load is segmented into a number of time intervals. In each time segment, the nonstationary load is represented by the produce of a deterministic shaping function and a statistically stationary random function. An approximate modelling of the load on the wing is given. The wing is divided into panels or elements, and the load is computed from measured or estimated pressure fluctuations at the center of each panel. A series representation, with terms of the correlated noise type, is used to curve fit the experimentally determined complex buffet pressure power spectral densities. Using the correlated noise form of power spectral density for the random part of the applied load, analytic expressions are derived for the mean square displacement and acceleration response of the wing. An illustration using data available for the F-4E aircraft is included. Author (GRA)

N81-17044# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

COMPARISON OF FLIGHT LOAD MEASUREMENTS OBTAINED FROM CALIBRATED STRAIN GAGES AND PRESSURE TRANSDUCERS Final Report, Nov. 1976 - Feb. 1979

John W. Rustenburg Oct. 1980 52 p refs
(AD-A093758; ASD-TR-80-5038) Avail: NTIS HC A04/MF A01 CSCL 20/11

Net shear, bending moment, and torsion at one wing station derived from concurrent strain gage and pressure transducer measurements are compared. Comparisons are made for results from normal and abrupt symmetrical pullup/pushdown, and rolling pullout maneuvers at subsonic and supersonic speeds and four wing sweeps. With few exceptions good to very good correlation is shown. GRA

N81-17045# Southampton Univ. (England). Dept. of Electrical Engineering.

STATIC CHARGE IN AIRCRAFT FUEL TANKS Final Technical Report, 1 Jul. 1977 - 30 Sep. 1979

Charles R. Martel Sep. 1980 38 p refs
(Grant AF-AFOSR-3373-77; AF Proj. 2301; AF Proj. 3048)
(AD-A093552; AFWAL-TR-80-2049) Avail: NTIS HC A03/MF A01 CSCL 01/2

This program investigates electrostatic hazards associated with aircraft fueling. The tribo electric phenomena of reticulated polyurethane foam charging was examined using JP-4. An attempt was made to understand the basic electrostatic phenomena involved when fuel is pumped into aircraft fuel tanks containing reticulated, polyurethane foam. The investigation also involved the development and study of alternative foam materials having enhanced electrical and charge dissipation characteristics as a means of eliminating the electrostatic hazards during refueling. GRA

N81-17046# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Fire Protection Branch.

FLAME TUBE AND BALLISTIC EVALUATION OF EXPLOSAFE ALUMINUM FOIL FOR AIRCRAFT FUEL TANK EXPLOSION PROTECTION Final Report, Aug. 1977 - Mar. 1979

Thomas A. Hogan and Charles Pedriani Apr. 1980 107 p refs
(AF Proj. 3048; DA Proj. 1L1-62209-AH-76)
(AD-A093542; AFWAL-TR-80-2031) Avail: NTIS HC A06/MF A01 CSCL 11/6

This report presents the combustion and gunfire testing conducted by the AFWAL/PO and the AVRADCOM/Applied

Technology Laboratory in support of a joint USAF/Army and Canadian Government project to evaluate an advanced metal foil explosion suppressor called Explosafe for potential use in protecting aircraft fuel tanks. This material is manufactured by Vulcan Industrial Packaging Limited, (VIPL), Explosafe Division, and is processed by slitting, expanding and stacking aluminum foil into batts. The density is varied either by changing the foil thickness at a constant expansion width or by changing the expansion width at a constant foil thickness. The scope of this in-house program was to determine: (1) the material's ability to suppress combustion overpressures through small scale laboratory testing and through full scale ballistic testing, (2) to establish an optimum material density versus performance and (3) to compare the results to the reticulated polyurethane foam. The AFWAL/PO conducted the laboratory tests in a flame tube over several densities of 3 foil thicknesses and the Army conducted the ballistic tests in a heavy structural fuel tank over 3 densities of 3 foil thicknesses. Results of these tests indicated that a 2.0 mil foil around the 2.0 no./cu ft region was an optimum foil thickness and weight density to be used in the remaining tests of the joint program. GRA

N81-17047# Vulcan Industrial Packaging Ltd., Rexdale (Ontario). EXPLOSAFE Div.

EVALUATION OF EXPLOSAFE. EXPLOSION SUPPRESSION SYSTEM FOR AIRCRAFT FUEL TANK PROTECTION Final Report, Jul. 1977 - Jul. 1 1980

Andrew Szego, Karim Premji, and Robert D. Appleyard Wright-Patterson AFB, Ohio AFWAL Jul. 1980 465 p

(Contract F33615-77-C-3115; AF Proj. 3048)

(AD-A093125; EDR-010-047; AFWAL-TR-80-2) Avail: NTIS HC A20/MF A01 CSCL 01/3

A joint USAF/Canadian government development program conducted to evaluate the fuel tank ullage explosion suppression performance and to qualify the airborne military use of EXPLOSAFE void filler material, is reported. The material was subjected to laboratory testing to characterize its performance with regard to the manufacturing variables and subsequently exposed to typical ballistic threats up to 23mm HEI-T. The material properties are extensively defined together with the operational penalties associated with its use. Operational and environmental tests are described which determined the tolerance of the material to static loading, fuel slosh vibration, and exposure to fuel, fuel and additives, and corrosive fuel contaminants. Further tests demonstrate that the material does not affect fuel system operation with regard to flow, free motion of fuel during aircraft inversion and fuel tank venting. Installation studies were conducted on fuel tanks of varying complexity to demonstrate feasibility of assembly using existing apertures. GRA

N81-17048# Texas Univ. at Austin. Center for Aeronautical Research.

THE EFFECTS OF WARHEAD-INDUCED DAMAGE ON THE AEROELASTIC CHARACTERISTICS OF LIFTING SURFACES. VOLUME 2: AERODYNAMIC EFFECTS Final Report, 1 Feb. 1979 - 1 Mar. 1980

J. C. Westkaemper and R. M. Chandrasekharan Jul. 1980 116 p refs

(Grant AF-AFOSR-3569-78; AF Proj. 2301)

(AD-A093063; AFOSR-80-1040TR) Avail: NTIS HC A06/MF A01 CSCL 20/4

Tests were made in a subsonic wind tunnel to determine the effects of damage on the aerodynamic characteristics of a T-38 aircraft stabilator half. Six damage configurations were used, one circular and the remainder trapezoidal in planform, with areas of up to 2 percent of the stabilator area. The damage holes were all ahead of the 50 percent chord line, with centers at 43, 60, and 75 percent span. Surface pressure distributions and lift and drag coefficients were measured. The 65A004 airfoil used is subject to leading edge separation which strongly influenced the results. In the absence of separation, damage effects tended to be localized and aerodynamic degradation was modest. With extensive separation, the damage influence propagated completely across the span, with more substantial degradation. There was up to 300 percent increase on CD sub o, but at moderate lift coefficients the drag increase was generally insignificant. The decrease in C sub L was more consistent, ranging up to 10 percent for the larger damage holes. GRA

N81-17049# Technische Hochschule, Aachen (West Germany). Lehrstuhl fuer Luft- und Raumfahrt.

ON THE FLIGHT MECHANICS OF REMOTELY PILOTED VEHICLES [ZUR FLUGMECHANIK VON RPV'S]

R. Staufenbiel Bonn Bundesministerium fuer Verteidigung 1979 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteidigung

(BMVg-FBWT-79-28) Avail: NTIS HC A04/MF A01

The dynamic characteristics which are important for the design of small remotely piloted vehicles (RPVs; MINI-RPVs) are considered. In particular, the influence of vehicle size on longitudinal motion stability, vehicle response to vertical and longitudinal gusts, and on performance are examined. Results show that longitudinal motion can be scaled for vehicles of different size by introducing a suitable reference length and a relative mass parameter. Gust sensitivity and landing technique are shown to be important aspects for small RPVs. A special configuration, based on a circular wing, was developed for a MINI-RPV and was successfully in a wind tunnel as well as during remotely controlled test flights. Author (ESA)

N81-17050# Societe Nationale Industrielle Aerospatiale, Cannes (France).

EVOLUTION OF MATERIALS AND ASSOCIATED TECHNOLOGIES IN THE MAKEUP OF AEROSPACE MATERIALS, PART 1 [EVOLUTION DES MATERIAUX ET DES TECHNOLOGIES ASSOCIEES DANS LES STRUCTURES DE MATERIELS AEROSPATIAUX. PREMIERE PARTIE]

G. Sertour and G. Hilaire Paris Association Aeronautique et Astronautique de France 1979 29 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979 2 Vol.

(AAAF-NT-79-22-Pt-1; ISBN-2-7170-0569-2) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

A historical survey of the aerospace construction industry is presented. Emphasis is on the development of aluminum alloys and on laboratory techniques for testing their in service behavior. Crack propagation studies and results concerning stress corrosion cracking are covered. Manufacturing techniques, notably press forming, are examined. Recent results in the use of plastics, mainly carbon epoxy composites, are mentioned and their development, is seen as opening a new era in aerospace technology. Author (ESA)

N81-17051# Societe Nationale Industrielle Aerospatiale, Cannes (France).

EVOLUTION OF MATERIALS AND ASSOCIATED TECHNOLOGIES IN THE MAKEUP OF AEROSPACE MATERIALS. PART 2: EXAMPLES [EVOLUTION DES MATERIAUX ET DES TECHNOLOGIES ASSOCIEES DANS LES STRUCTURES DE MATERIELS AEROSPATIAUX. DEUXIEME PARTIE]

G. Sertour and G. Hilaire Paris Association Aeronautique et Astronautique de France 1979 31 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979 2 Vol.

(AAAF-NT-79-22-Pt-2; ISBN-2-7170-0570-6) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

As part of a historical survey of the aerospace construction industry, examples of the use of technological advances in materials sciences and process engineering are offered. These include an overview of the fabrication of first stage fuel tanks for ARIANE as well as of the development of a double payload launch system (SYLDA) for the same vehicle. Also covered are in exhausst nozzle housing (MIRAGE 2000), a swing wing tip (CONCORDE), a lift dumper (AIRBUS A 300 B), and a light alloy casing (INTELSAT 5). The MARECS satellite antenna, a rigid solar generator, carbon carbon composites, and the use of Kevlar are discussed as well. Author (ESA)

N81-17052# Societe Nationale Industrielle Aerospatiale, Marignane (France.) Dept. Scientifique.

NEW MATERIALS AND HELICOPTER CERTIFICATION [MATERIAUX NOUVEAUX ET CERTIFICATION DES HELICOPTERES]

F. Liard Paris Association Aeronautique et Astronautique de France 1979 25 p In FRENCH Presented at 14th Intern.

AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-26; ISBN-2-7170-0574-9) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

Citing the AS 350 series helicopter as an example, problems posed for the certification of an aircraft whose structure is made up of newly developed or experimental materials, mainly fiber reinforced plastic composites or laminates, are discussed. Defining the resistance of a sturcture as to static strength and fatigue strength is dealt with. The influence of aging, either artificially for test purposes or natural aging, is also considered. Quality control, crash behavior, reaction to fire, and vibration stress behavior of helicopter structures are mentioned. Comparison with metallic materials is made. Author (ESA)

N81-17053# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
A CONVERSATIONAL, TOPOLOGICAL GRID METHOD AND OPTIMIZATION OF STRUCTURAL CALCULATIONS INVOLVING FINITE ELEMENTS [MAILLAGE PAR METHODE TOPOLOGIQUE CONVERSATIONNELLE ET OPTIMISATION DANS LES CALCULS DE STRUCTURE PAR ELEMENTS FINIS]
C. Petiau Paris Association Aeronautique et Astronautique de France 1979 32 p refs In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-30; ISBN-2-7170-0578-I) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

A finite element code used in the structural analysis and design of MIRAGE aircraft is studied. Particular attention is given to two modules of this program: (1) the elaboration of a three dimensional grid representation, based on a topological method; and (2) a linear optimization of the structural stability parameters. A progressive shift in data input techniques towards a man machine conversational mode is also discussed. Stress concentration results, including aeroelasticity data, and associated computer graphics are shown, using the MIRAGE 2000 aircraft as an example. Author (ESA)

N81-17054# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France). Bureau de Calculs des Structures.
LIMITING APPLICATION OF THE CONCEPT 'DAMAGE TOLERANCE' WITH REGARD TO FIGHTER AIRCRAFT [LES LIMITES DE L'APPLICATION DE LA CONCEPTION TOLERANCE AUX DOMMAGES AUX AVIONS D'ARMES]
D. Chaumette Paris Association Aeronautique et Astronautique de France 1979 29 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-32; ISBN-2-7170-0580-3) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

The safety standard concepts fail safe, safe life, and damage tolerance as defined by civil norms and military specifications are examined. Specifically, their application to a coherent maintenance program for military aircraft is considered. Experience gained with MIRAGE aircraft justifies using damage tolerance norms, however, this concept as detailed in US MIL 83444 is seen as too rigid. A more pragmatic approach, making use of fatigue tests in designing structures that are both reasonably resistant to fabrication defects and easily inspected in service, is suggested. Author (ESA)

N81-17055# Lille Univ. (France). Inst. de Mecanique des Fluides.
LABORATORY STUDIES OF FLIGHT MECHANICS USING CATAPULT LAUNCHED MODELS [ETUDES DE MECANIQUE DU VOL PAR MAQUETTES CATAPULTEES EN LABORATOIRE]
J. L. Cocquerez Paris Association Aeronautique et Astronautique de France 1980 51 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-15; ISBN-2-7170-0611-7) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

A laboratory installation for the free flight testing of aircraft scale models is described. Models two to three meters in length and weighing up to 40 kg can be handled. The use of miniaturized high performance sensors and flight controls associated with numerical systems for telemetry and remote control is also shown. Results obtained using catapult launched models of commercial and fighter aircraft are given as examples of typical test programs. These include aircraft response to lateral gusts simulated in a wind tunnel, impact study of a belly landing, and flight characteristics at high angle of incidence for the Mirage 2000 as well as aircraft response to vertical turbulence for the same aircraft model. Author (ESA)

N81-17056# Lille Univ. (France). Inst. de Mecanique des Fluides.
MODELING, ACQUISITION AND PROCESSING DURING LARGE DISPLACEMENTS [MODELISATION - ACQUISITION - TRAITEMENT LORS DE GRANDS MOUVEMENTS]
W. Charon and P. Coton Paris Association Aeronautique et Astronautique de France 1980 24 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-16; ISBN-2-7170-0612-5) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

Data conditioning and analysis methods, generally downline from data collection on experiments in flight mechanics, are briefly described. An optimal PCM telemetry data acquisition chain is outlined. The restitution of experimental parameters from raw data through the use of sampling windows is discussed. Numerical filtering techniques are cited. Mathematical modeling, especially of nonlinear systems, is treated and the possibility of a model which covers the entire domain of dynamic response of an aircraft in flight is considered. Experimental error detection and the setting of confidence limits relative to the calculation of aerodynamic coefficients are also covered. Author (ESA)

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also 19 Spacecraft Instrumentation and 35 Instrumentation and Photography.

N81-17057* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
SKIN FRICTION MEASURING DEVICE FOR AIRCRAFT Patent
Lawrence C. Montoya and Donald R. Bellman, inventors (to NASA) Issued 23 Dec. 1980 8 p Filed 7 Aug. 1979 Supersedes N79-31139 (17 - 22, p 2895)
(NASA-Case-FRC-11029-1; US-Patent-4,240,290; US-Patent-Appl-SN-164617; US-Patent-Class-73-178R; US-Patent-Class-73-147) Avail: US Patent and Trademark Office CSCL 01D

A skin friction measuring device for measuring the resistance of an aerodynamic surface to an airstream is described. It was adapted to be mounted on an aircraft and is characterized by a friction plate adapted to be disposed in a flush relationship with the external surface of the aircraft and be displaced in response to skin friction drag. As an airstream is caused to flow over the surface, a potentiometer connected to the plate for providing an electrical output indicates the magnitude of the drag.
Official Gazette of the U.S. Patent and Trademark Office

N81-17058# Crew Systems Consultants, Yellow Springs, Ohio.
OPERATIONAL PROBLEMS ASSOCIATED WITH HEAD-UP DISPLAYS DURING INSTRUMENT FLIGHT Final Report
Richard L. Newman Oct. 1980 231 p refs
(Contract F33615-79-C-0521; AF Proj. 7184)
(AD-A092992; AFAMRL-TR-80-116) Avail: NTIS HC A11/MF A01 CSCL 05/8

Because of the interest in using head-up displays (HUDs) as primary flight references in instrument meteorological conditions (IMC), a survey of operational pilots flying HUD-equipped airplanes was undertaken. This survey revealed several problem areas that were common to most of the HUDs used. These common problem areas were: the HUDs were too bright at night; the field of view was too limited; and the location of the design eye reference point does not correspond to the typical pilot practice of sitting

as high as possible to maintain good visibility. Other problem areas were reported, including: the response of the HUD symbols is not adequately controlled by existing specifications; pilots have an increased tendency toward disorientation while flying by reference to the HUD; the instrument landing system (ILS) displays in use are not satisfactory; and the balance between presenting necessary information and presenting too much is not always achieved on today's HUDs. Concurrently with the review of operational problems, a review of HUD-related training was undertaken. This review shows that very little attention is being paid to initial and recurrent HUD training or to the development of HUD procedures for flight in IMC. GRA

N81-17059# Simmonds Precision Products, Inc., Vergennes, Vermont. Instrument Systems Div.
EFFECTS ON ANTI-STATIC ADDITIVES ON AIRCRAFT CAPACITANCE FUEL GAGING SYSTEMS Final Report, May - Nov. 1979
P. Weitz and D. Slade Jun. 1980 58 p
(Contract F33657-79-C-0378; AF Proj. 3048)
(AD-A092907; E-2239; AFWAL-TR-80-2058) Avail: NTIS HC A04/MF A01 CSCL 21/4

The effects of increasing the electrical conductivity of JP-4 and Jet A jet fuels on aircraft capacitance fuel gauging systems were determined. Fuel tank capacitance probes from the KC-135, A-7, F-15, and F-16 aircraft were tested in JP-4 and Jet A fuels having electrical conductivities ranging from less than 20 pS/m to 5,000 pS/m. Additives ASA-3 (Shell Chemical Company) and Stadis 450 (E.I. Du Pont de Nemours and Company) were used to increase the conductivity of the fuel. The fuel tank capacitance guaging system parameters of accuracy, sensitivity, speed of response, and High Z null voltage were measured. The F-15 and the F-16 systems were unaffected by fuel conductivities up to 5,000 pS/m. The A-7 and KC-135 systems indicated negligible effects at fuel conductivities up to 500 pS/m, and increasing system degradation at higher conductivity levels. GRA

N81-17060# McDonnell Aircraft Co., St. Louis, Mo.
ENVIRONMENTAL BURN-IN EFFECTIVENESS Final Report, May 1979 - Aug. 1980
J. R. Anderson Wright-Patterson AFB, Ohio AFWAL Aug. 1980 168 p refs
(Contract F33615-79-C-3411; AF Proj. 2402)
(AD-A093307; AFWAL-TR-80-3086) Avail: NTIS HC A08/MF A01 CSCL 14/2

This report considers the effectiveness of current industry practice in the burn-in of avionics equipment. The burn-in test results for six avionics systems are analyzed using the chance Defective Exponential model for the failure rate. Based on the mode, effectiveness measures for burn-in are developed. Flight test results are also evaluated to determine the adequacy of current burn-in techniques. Cost effectiveness considerations for the burn-in process are addressed. Results of an industry survey on current practice and opinions concerning various issues in the burn-in of avionics are presented. GRA

N81-17061# Perceptronics, Inc., Woodland Hills, Calif.
ANALYSIS AND MODELING OF INFORMATION HANDLING TASKS IN SUPERVISORY CONTROL OF ADVANCED AIRCRAFT Annual Technical Report
Yee-Yee Chu, Randall Steeb, and Amos Freedy Jun. 1980 123 p refs
(Contract F49620-79-C-0130; AF Proj. 2313)
(AD-A092906; PATR-1080-80-6; AFOSR-80-1190TR) Avail: NTIS HC A06/MF A01 CSCL 01/2

This report describes research and development centered on evaluation of information needs and automated management of information displays in advanced aircraft operations. Techniques for information selection were developed based on Multi-Attribute Utility (MAU) models and queueing theory formulations. These techniques take into account both subjective factors and objective situational conditions, as well as the immediate information monitoring and control needs of the operator and the impact on other unattended processes. The combined MAU/queueing model was tested in a Monte Carlo simulation. The experiment compared performance of the MAU-based policy to other priority policies both in event selection and information source selection. Initial results suggest that the value-based model is suitable for concurrent evaluation of information source and event sequence. The information management concept based on the MAU model seems to be superior to those based on traditional priority assignment. Possible applications of the approaches and the plan for further validation are also discussed. GRA

N81-17062# Dynamics Research Corp., Wilmington, Mass.
DIGITAL AVIONICS INFORMATION SYSTEM (DAIS): LIFE CYCLE COST IMPACT MODELING SYSTEM (LCCIM). A MANAGERIAL OVERVIEW Final Report
John C. Goclowski and H. Anthony Baran Brooks AFB, Tex. AFHRL Nov. 1980 41 p refs
(Contract F33615-75-C-5218; AF Proj. 2051)
(AD-A093281; AFHRL-TR-79-4) Avail: NTIS HC A03/MF A01 CSCL 05/1

This report provides an overview of the Life Cycle Cost Impact Modeling System (LCCIM). The LCCIM can be used to assess the impact of weapon system characteristics on system support resource requirements and life cycle cost (LCC). It was developed to enhance present Air Force capability to conduct tradeoffs between competing design, manpower, and ligistics alternatives early in the weapon systems acquisition process. This report also contains a general description of the initial application of the LCCIM an analysis of the potential impacts of the Digital Avionics Information System (DAIS) Concept of avionics integration on LCC and system support personnel requirements. References are provided for other related reports which describe that application, document the development of LCCIM components and provide user's guide information and computer program listings. GRA

N81-17063# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
ADVANCEMENT ON VISUALIZATION TECHNIQUES
Walter M. Hollister, ed. (MIT) Oct. 1980 217 p refs
(AGARD-AG-255; AGARDograph-255; ISBN-920835-1371-1)
Avail: NTIS HC A10/MF A01

Principles, technology, and applications in the field of visualization and display in aircraft cockpits are discussed. Topics include liquid crystals, light emitting diodes, electroluminescent displays, and gas plasma panels, as well as, helmet mounted display devices and human factors engineering. For individual titles, see N81-17064 through N81-17077.

N81-17064# Cranfield Inst. of Tech., Bedfordshire (England).
THE PRESENTATION OF STATIC INFORMATION ON AIR TRAFFIC CONTROL DISPLAYS Ph.D. Thesis
R. J. G. Edwards *In* AGARD Advan. on Visualization Tech. Oct. 1980 44 p refs (For primary document see N81-17063 08-06)
Avail: NTIS HC A10/MF A01

The physical characteristics of display consistent with human performance are defined. Eight display characteristics were selected as critically important, they are: (1) frame rate; (2) contrast ratio; (3) ambient illumination; (4) symbol characteristics; (5) resolution; (6) bandwidth; (7) registration; and (8) phosphor type. The exact priority of each characteristics and the specific result of their interrelationships is a function of the particular application and is considered with respect to an ATC display environment. E.D.K.

N81-17065# Naval Air Development Center, Warminster, Pa.
FLAT PANEL DISPLAY TECHNOLOGY REVIEW
James Brindle, Brad Gurman (Army Avionics Res. and Develop. Activity, Ft. Monmouth), Joseph Redford (Army Aviation Res. and Develop. Command, St. Louis), Elliot Schlam (Army Electron. Res. and Develop. Command, Ft. Monmouth), William Mulley, Parviz Soltan (Naval Ocean Systems Center, San Diego), George Tsaparas (Naval Air Systems Command, Arlington), Keith B. Urnette (AFFDL, Wright-Patterson AFB), John Coonrod (AFAL, Wright-Patterson AFB), and Walter Melnick (AFFDL, Wright-Patterson AFB) *In* AGARD Advan. on Visualization Tech. Oct. 1980 5 p (For primary document see N81-17063 08-06)
Avail: NTIS HC A10/MF A01

There are three display media presently receiving the most attention and which appear to be the most promising. These are: (1) electroluminescence (EL); (2) light emitting diode (LED);

and (3) liquid crystal (LC). There are other technologies that also appear promising but that have not advanced in development to the point where they are receiving serious consideration for aircraft use or that have serious limitations, some of which may be eliminated in time. These include plasma, electrochromic, electrophoretic, ferroelectric, magnetic particle, and microchannel playe display technologies. In order to exploit flat panel display media, development of suitable addressing techniques is required. Three representative methods of addressing display media (silicon, thin-film transistor (TFT) and crossed electrodes) are discussed. E.D.K.

N81-17066# Royal Aircraft Establishment, Farnborough (England).

THE ELECTRO-OPTICAL DISPLAY/VISUAL SYSTEM INTERFACE: HUMAN FACTORS CONSIDERATIONS

J. Laycock and R. A. Chorley (Aerospace & Defence Systems Co., Cheltenham, England) *In* AGRAD Advan. on Visualization Tech. Oct. 1980 15 p refs (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

Display systems are currently developed by a cyclical two stage process. Equipment is developed, and there is then a period in which its suitability for use by an operator is assessed. The results of the evaluation determine the modifications to be introduced into the next cycle of the process. This paper considers the possibility of adopting a design strategy which initially asseses operator performance and then uses the result of this assessment to determine what equipment development would best meet the requirements of the operator. As the subject under consideration is visual display systems, the text considers only the visual aspects of human performance and relates these attributes to display parameters. Author

N81-17067# Ferranti Ltd., Edinburgh (Scotland). Electronics Systems Dept.

INTEGRATION OF SENSORS WITH DISPLAYS

Alan C. Wesley and Ian T. B. Blackie *In* AGARD Advan. on Visualization Tech. Oct. 1980 25 p (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

The sensors commonly found on military aircraft often provide information for display. The various categories of displays available are described with their signal characteristics, cockpit location, and operational uses, together with a discussion on their particular suitability to provide integrated sensor/display systems. Author

N81-17068# Royal Signals and Radar Establishment, Malvern (England).

LIQUID CRYSTAL DISPLAYS

A. J. Hughes *In* AGARD Advan. on Visualization Tech. Oct. 1980 15 p refs (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

An introduction is given to the physical properties of liquid crystals and the electro-optic effects that may be used for display purposes. A more detailed description follows of both the twisted nematic effect, as used in the vast majority of current liquid crystal displays, and of the dyed phase-change effect, which is a likely candidate eventually to supercede the twisted nematic display. The performance and limitations of simple, directly driven displays are analyzed, and the problems and difficulties associated with more complex, matrix addressed displays are described. Finally, a brief description is given of a selection of laboratory prototypes and drive methods that demonstrate the progress of liquid crystal research towards solving the various problems associated with high complexity displays. Author

N81-17069# Thorn-Brimar Ltd., Chadderton (England).

CATHODE RAY TUBES AND PLASMA PANELS AS DISPLAY DEVICES FOR AIRCRAFT DISPLAYS

Stewart Woodcock *In* AGARD Advan. on Visualization Tech. Oct. 1980 8 p refs (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

The various types of electronic display presently being incorporated in aircraft and the displays being proposed for future use are reviewed and their technical requirements examined. These include head-up displays, helmet mounted displays, and various head-down displays which can be generated by TV techniques. The state of the art of CRT and d.c. plasma technology is described and the suitability of these two devices for the different displays is discussed, along with possible future improvements in performance. Author

N81-17070# Thomson-CSF, Paris (France). Div. Tubes Electroniques.

LARGE AREA GAS DISCHARGE DISPLAYS

J. P. Michel *In* AGARD Advan. on Visualization Tech. Oct. 1980 6 p refs (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

Gas discharge displays or plasma displays are generally classed as a.c. displays, and d.c. displays. In d.c. displays the electrodes or resistive extension of these are immersed in the gas (ac operation would be possible but almost always discharge currents are unidirectional). In a.c. displays, a dielectric surface isolates the electrodes from the gas with which they only have an electrostatic coupling and only a.c. operation is possible. Both can be operated in a storage or nonstorage mode (storage meaning that the memory is inherent to the display device, whereas in the nonstorage or cyclic mode the memory is external to the display and the image information is transferred to the display device sequentially and refreshed frequently enough to avoid flicker). E.D.K.

N81-17071# Air Force Human Resources Lab., Wright-Patterson AFB, Ohio. Operational Training Div.

OPTICAL INFINITY LENS DEVELOPMENT FOR FLIGHT SIMULATOR VISUAL DISPLAYS

William B. Albery and Joseph A. LaRussa *In* AGARD Advan. on Visualization Tech. Oct. 1980 9 p refs Prepared in cooperation with Farrand Optical Co., Inc., Valhalla, N.Y. (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

A very fast, large aperture magnifying optical package was developed which can present to the observer a displayed image at optical infinity. The Pancake Window, so called because of its minimal depth and relatively flat appearance, is currently being used in two Air Force flight simulator visual displays. The optical quality of this magnifier is due to the fact that it is comprised of reflective, and not refractive elements. The advantages of its configuration as an on-axis reflective system and the optical properties of its elements are presented. The latest improvement to its development, incorporation of a spherical holographic beamsplitter mirror, is discussed. This development holds promise for reducing both the cost and weight of the package. A technique for reducing unwanted optical effects by tilting the birefringent package of the window is also discussed. E.D.K.

N81-17072# Ferranti Ltd., Edinburgh (Scotland). Inertial Systems Dept.

EVOLUTION OF TACTICAL AND MAP DISPLAYS FOR HIGH PERFORMANCE AIRCRAFT

W. H. McKinlay *In* AGARD Advan. on Visualization Tech. Oct. 1980 8 p refs (For primary document see N81-17063 08-06)

Avail: NTIS HC A10/MF A01

The operational problems which determine the display characteristics of high performance military aircraft are particularly exacting in tactical operations flown at low altitudes over land. Because these operations are related to the terrain, situation displays having map like characteristics have become important and are now being embodied in full electronic display systems for aircraft. In such aircraft, the need to conserve display area and handle sensor data in the context of the terrain has led to combined display techniques. The display requirements and the available technologies are considered. It is suggested that the optically combined display based on film storage is the most notable solution available today although several different electronic solutions are being or could be developed. Some conclusions as to the relative significance of the difference alternative solutions are given. E.D.K.

N81-17073# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Visual Display Systems Branch.

HELMET MOUNTED DISPLAYS: DESIGN CONSIDERATIONS

H. Lee Task, Dean F. Kocian, and James H. Brindle *In* AGARD Advan. on Visualization Tech. Oct. 1980 13 p refs Prepared in cooperation with Naval Air Development Center, Warminster, Pa. (For primary document see N81-17063 08-06)
Avail: NTIS HC A10/MF A01

Several parameters that must be considered in the design of a helmet mounted display (HMD) are described. The parameters discussed include: size, weight, exit pupil, eye relief, field of view, collimation, distortion, and image quality. Detailed discussion and specific related equations are provided for many of these variables. Optical design approaches to HMD's are discussed with reference to specific systems. A summary table is included that shows the values of many HMD design parameters for six HMD's. The HMD image sources, both present and future, are presented. E.D.K.

N81-17074*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ADVANCED ELECTRONIC COCKPIT INSTRUMENTATION SYSTEM: THE COORDINATED COCKPIT DISPLAY
D. L. Baty and M. L. Watkins *In* AGARD Advan. on Visualization Tech. Oct. 1980 11 p refs Prepared in cooperation with San Jose State University Foundation, Calif. (For primary document see N81-17063 08-06)
Avail: NTIS HC A10/MF A01 CSCL 01D

Cathode ray tube (CRT) and computer technologies have reached the stage where current flight and engine instruments can economically be replaced by computer controlled CRT displays. This provides a tremendous opportunity for flexibility to the cockpit display designer, but the use of this flexibility should stay within the realities of the flight environment. One approach to the replacement of flight instruments is described, using three separate color CRT's. Each CRT displays information pertinent to one of the three orthogonal projections of the aircraft flight situation. Three airline pilots made a preliminary assessment of this display set. Comments, rankings, and ratings show that, in general, the pilots accepted the concept of pictorial flight displays. E.D.K.

N81-17075# British Aerospace Aircraft Group, Brough (England). Kingston-Brough Div.
THE INFLUENCE OF VISUAL REQUIREMENTS ON THE DESIGN OF MILITARY COCKPITS
J. W. Lyons and G. Roe *In* AGARD Advan. on Visualization Tech. Oct. 1980 29 p refs (For primary document see N81-17063 08-06)
Avail: NTIS HC A10/MF A01

The effect of visual requirements for combat aircraft is discussed with emphasis on the next generation of fighters. External vision is vital for success in air to air engagements, hence the need to define canopy lines with extreme care. The criteria for doing this are discussed in some detail. Problems of internal vision are discussed next. Cockpit display layout is considered from the point of view of moding and presentation of information as well as the more human factors problems of search. An insight into the workload aspects of cockpit assessment is included. E.D.K.

N81-17076# Grumman Aerospace Corp., Bethpage, N.Y. Guidance and Control Dept.
DISPLAY CONCEPTS FOR CONTROL CONFIGURED VEHICLES
Robert W. Klein and Walter M. Hollister *In* AGARD Advan. on Visualization Tech. Oct. 1980 13 p refs Prepared in cooperation with MIT, Cambridge (For primary document see N81-17063 08-06)
(Grant AF-AFOSR-3260-78)
Avail: NTIS HC A10/MF A01

The unique flight modes of a control configured vehicle (CCV) need to be taken into account in the design of displays for these craft. Several compensatory displays are suggested and evaluated using a fixed base, F-16 CCV simulation. The displays were found to enhance the improved tracking performance available when CCV modes are used in comparison to conventional flight. Author

N81-17077# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. Flight Mechanics Div.
EXPERIMENTS USING ELECTRONIC DISPLAY INFORMATION
Samuel A. Morello *In* AGARD Advan. on Visualization Tech. Oct. 1980 10 p refs (For primary document see N81-17063 08-06)
Avail: NTIS HC A10/MF A01 CSCL 01D

The results of research experiments concerning pilot display information requirements and visualization techniques for electronic display systems are presented. Topics deal with display related piloting tasks in flight controls for approach-to-landing, flight management for the descent from cruise, and flight operational procedures considering the display of surrounding air traffic. Planned research of advanced integrated display formats for primary flight control throughout the various phases of flight is also discussed. E.D.K.

N81-17146* National Aeronautics and Space Administration, Washington, D. C.
SAFETY POLICY AND REQUIREMENTS FOR PAYLOADS USING THE SPACE TRANSPORTATION SYSTEM
P. D. Davis *In its* The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 1-6 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 22A

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N81-17078*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
TURBINE MODELING TECHNIQUE TO GENERATE OFF-DESIGN PERFORMANCE DATA FOR BOTH SINGLE AND MULTISTAGE AXIAL-FLOW TURBINES Contractor Report, Aug. 1979 - Aug. 1980
G. L. Converse Feb. 1981 46 p refs
(Contract NAS3-21999)
(NASA-CR-165244; R81AEG219) Avail: NTIS HC A03/MF A01 CSCL 21E

This technique is applicable to larger axial flow turbines which may or may not incorporate variable geometry in the first stage stator. A user specified option will also permit the calculation of design point cooling flow levels and the corresponding change in turbine efficiency. The modeling technique was incorporated into a time sharing computer program in order to facilitate its use. Because this report contains a description of the input output data, values of typical inputs, and example cases, it is suitable as a user's manual. T.M.

N81-17079*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
COMBUSTOR LINER DURABILITY ANALYSIS Final Report
V. Moreno Feb. 1981 84 p refs
(Contract NAS3-21836)
(NASA-CR-165250; PWA-5684-19) Avail: NTIS HC A05/MF A01 CSCL 21E

An 18 month combustor liner durability analysis program was conducted to evaluate the use of advanced three dimensional transient heat transfer and nonlinear stress-strain analyses for modeling the cyclic thermomechanical response of a simulated combustor liner specimen. Cyclic life prediction technology for creep/fatigue interaction is evaluated for a variety of state-of-the-art tools for crack initiation and propagation. The sensitivity of the initiation models to a change in the operating conditions is also assessed. A.R.H.

N81-17080*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
JT8D-15/17 HIGH PRESSURE TURBINE ROOT DISCHARGED BLADE PERFORMANCE IMPROVEMENT Contractor Report, Sep. 1978 - Aug. 1980
A. S. Janus 18 Feb. 1981 60 p refs
(Contract NAS3-20630)
(NASA-CR-165220; PWA-5515-138) Avail: NTIS HC A04/MF A01 CSCL 21E

The JT8D high pressure turbine blade and seal were modified, using a more efficient blade cooling system, improved airfoil aerodynamics, more effective control of secondary flows, and improved blade tip sealing. Engine testing was conducted to determine the effect of these improvements on performance. The modified turbine package demonstrated significant thrust specific fuel consumption and exhaust gas temperature improvements in sea level and altitude engine tests. Inspection of the improved blade and seal hardware after testing revealed no unusual wear or degradation. R.C.T.

N81-17081*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 1: DESIGN LAYOUTS
D. P. Nelson Jan. 1981 40 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-1; PWA-5550-50-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 21E

The design layouts and detailed design drawings of coannular exhaust nozzle models for a supersonic propulsion system are presented. The layout drawings show the assembly of the component parts for each configuration. A listing of the component parts is also given. M.G.

N81-17082*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 2: TABULATED AEROYNAMIC DATA BOOK 1
D. P. Nelson Jan. 1981 400 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-2-Bk-1; PWA-5550-50-Vol-2-Bk-1) Avail: NTIS HC A17/MF A01 CSCL 21E

Tabulated data from wind tunnel tests conducted to evaluate the aerodynamic performance of an advanced coannular exhaust nozzle for a future supersonic propulsion system are presented. Tests were conducted with two test configurations: (1) a short flap mechanism for fan stream control with an isentropic contoured flow splitter, and (2) an iris fan nozzle with a conical flow splitter. Both designs feature a translating primary plug and an auxiliary inlet ejector. Tests were conducted at takeoff and simulated cruise conditions. Data were acquired at Mach numbers of 0, 0.36, 0.9, and 2.0 for a wide range of nozzle operating conditions. At simulated supersonic cruise, both configurations demonstrated good performance, comparable to levels assumed in earlier advanced supersonic propulsion studies. However, at subsonic cruise, both configurations exhibited performance that was 6 to 7.5 percent less than the study assumptions. At takeoff conditions, the iris configuration performance approached the assumed levels, while the short flap design was 4 to 6 percent less. Data are provided through test run 25. M.G.

N81-17083*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 2: TABULATED AERODYNAMIC DATA BOOK 2
D. P. Nelson Jan. 1981 446 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-2-Bk-2; PWA-5550-50-Vol-2-Bk-2) Avail: NTIS HC A19/MF A01 CSCL 21E

Tabulated aerodynamic data from coannular nozzle performance tests are given for test runs 26 through 37. The data include nozzle thrust coefficient parameters, nozzle discharge coefficients, and static pressure tap measurements. M.G.

N81-17084*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 2: TABULATED AERODYNAMIC DATA BOOK 3
D. P. Nelson Jan. 1981 467 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-2-Bk-3; PWA-5550-5-Vol-2-Bk-3) Avail: NTIS HC A20/MF A01 CSCL 21E

Tabulated data from wind tunnel tests evaluating the aerodynamic performance of coannular exhaust nozzles are given for test runs 37 through 65. M.G.

N81-17085*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 3: GRAPHICAL DATA BOOK 1
D. P. Nelson Jan. 1981 411 p refs
(Contract NAS3-20061)
(NASA-CR-159819-Vol-3-Bk-1; PWA-5550-50-Vol-3-Bk-1) Avail: NTIS HC A16/MF A01 CSCL 21E

A graphical presentation of the aerodynamic data acquired during coannular nozzle performance wind tunnel tests is given. The graphical data consist of plots of nozzle gross thrust coefficient, fan nozzle discharge coefficient, and primary nozzle discharge coefficient. Normalized model component static pressure distributions are presented as a function of primary total pressure, fan total pressure, and ambient static pressure for selected operating conditions. In addition, the supersonic cruise configuration data include plots of nozzle efficiency and secondary-to-fan total pressure pumping characteristics. Supersonic and subsonic cruise data are given. M.G.

N81-17086*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
MODEL AERODYNAMIC TEST RESULTS FOR TWO VARIABLE CYCLE ENGINE COANNULAR EXHAUST SYSTEMS AT SIMULATED TAKEOFF AND CRUISE CONDITIONS. COMPREHENSIVE DATA REPORT. VOLUME 3: GRAPHICAL DATA BOOK 2
D. P. Nelson Jan. 1981 482 p
(Contract NAS3-20061)
(NASA-CR-159819-Vol-3-Bk -2; PWA-5550-50-Vol-3-Bk-2) Avail: NTIS HC A21/MF A01 CSCL 21E

Graphical data from wind tunnel tests of variable cycle engine coannular exhaust nozzles are given. Specifically, aerodynamic data for takeoff conditions are presented. M.G.

N81-17087# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
SAMARIUM COBALT (SMCO) GENERATOR/ENGINE INTEGRATION STUDY Final Report, Aug. 1977 - Sep. 1979
Herbert F. Demel, Eike Richter, Charles F. Triebel, Robert C. Webb, and Max Baumgardner Wright-Patterson AFB, Ohio AFWAL Apr. 1980 348 p refs
(Contract F33615-77-C-2018; AF Proj. 3145)
(AD-A092904; R79AEG123; AFWAL-TR-80-2022) Avail: NTIS HC A15/MF A01 CSCL 21/5

This study consists of integrating a generator/starter internally on the engine rotor shaft, providing both secondary electric power and engine starting. The integrated engine generator/starter (IEG/S) has been analyzed and conceptually designed for three power levels and three engine categories. The preliminary layouts and supporting analysis of the rate earth, permanent magnet machine indicate that the IEG/S concept is a technically feasible approach to secondary power extraction and engine starting. GRA

N81-17088# Systems Control, Inc., Palo Alto, Calif.
TURBINE ENGINE FAULT DETECTION AND ISOLATION PROGRAM, PHASE 1. VOLUME 2: REQUIREMENTS DEFINITION FOR AN INTEGRATED ENGINE MONITORING SYSTEM Final Report, 15 Nov. 1978 - 15 Aug. 1979
Laura E. Baker, Ronald L. DeHoff, and W. Earl Hall, Jr. Wright-Patterson AFB, Ohio AFWAL Apr. 1980 270 p
(Contract F33615-78-C-2162; AF Proj. 3066)
(AD-A093226; AFWAL-TR-80-2053-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 21/5

Contents: Appendix A: Orientation Interview Analysis; Appendix B: Survey Design and Analysis; Appendix C: Engine Maintenance Support System Survey Responses; Appendix D: Task Force Review Transcripts. GRA

N81-17089# Systems Control, Inc., Palo Alto, Calif.
TURBINE ENGINE FAULT DETECTION AND ISOLATION PROGRAM, PHASE 1. VOLUME 1: REQUIREMENTS DEFINITION FOR AN INTEGRATED ENGINE MONITORING SYSTEM Final Report, 15 Nov. 1978 - 15 Aug. 1979
Laura E. Baker, Ronald L. Dehoff, and W. Earl Hall, Jr. Wright-Patterson AFB, Ohio AFWAL Apr. 1980 124 p refs
(Contract F33615-78-C-2062)
(AD-A093225; AFWAL-TR-80-2053-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 21/5

Automated engine monitoring has emerged as an important element in the Air Force's strategy to reduce propulsion system support costs and to improve aircraft operational availability. There has been a long history of development activity directed towards engine monitoring. These systems have demonstrated that sensor and automated data acquisition can be implemented effectively in both prototype and operational applications. Historically, however, no Air Force system has resulted in validated improvement in the engine maintenance and logistics process nor in a substantial cost savings. This situation is due in part to the fact that the performance data were not reduced to a concise, usable format relevant to the decision process of the maintenance personnel. Moreover, there was no procedure developed for integrating the performance data into the maintenance framework. This report presents the results of an intensive study of the Air Force maintenance/logistics process based on a selected sample of tactical bases, depots, and major commands. The objective is to define the requirements that the Air Force engine management structure imposes on automated data integration, in general, and engine performance monitoring, in particular. Such an automated integration of turbine engine monitoring system data with current data systems requries coordination between a variety of sources, both manual and automated. The results of this study are the requirements for such integration based on typical Air Force maintenance needs. GRA

N81-17090# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechanics.
THREE-DIMENSIONAL INTERNAL FLOWS IN TURBOMACHINERY, VOLUME 2 Final Report, Jan. 1978 - Jun. 1980
Kirti N. Ghia and Urmila Ghia Jun. 1980 70 p refs
(Contract F49520-78-C-0041; AF Proj. 2307)
(AD-A093130; AFOSR-80-1215TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

Several aspects of viscous internal flows, related to turbomachinery applications, are examined and studied with the use of appropriate model problems. Laminar as well as turbulent flows are considered. In particular, duct flows are studied in detail so as to better understand the physical phenomena occurring therein. This enables their appropriate formulation and, consequently, permits accurate numerical solutions to be obtained efficiently. Configurations involving complex geometry, transverse curvature, longitudinal curvature and streamwise flow separation are studied in detail. Turbulent flows through regular cross-section ducts are studied via the use of a two-equation model for the turbulence kinetic energy and its dissipation rate. Two approaches for treating the wall regions are examined and compared. Detailed results are obtained for flow through curved ducts of polar cross section. Some effort is also made towards modelling anisotropy and compressibility in turbulent flow using simple model problems. In the entire study, emphasis is given to the accuracy and efficiency of the numerical solutions. This has involved the study and implementation of implicit and semi-implicit numerical schemes of higher-order accuracy and higher efficiency. GRA

N81-17091# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commercial Products Div.
JT8D ENGINE INTERNAL EXHAUST MIXER TECHNOLOGY PROGRAM Final Report
F. H. Pond and R. A. Heinz Washington FAA Apr. 1980 147 p Sponsored by FAA
(AD-A093057; PWA-5584-33; FAA-RD-80-69) Avail: NTIS HC A07/MF A01 CSCL 21/5

This technology program was directed towards demonstrating the reduction in jet noise achieved by the use of an internal exhaust mixer. The effort focused on static engine acoustic testing of different mixer configurations suitable for JT8D-powered commercial aircraft. A series of 12 lobe mixers with different lobe geometries was evaluated for performance and acoustic characteristics. On the basis of test results, the final mixer configuration selected for JT8D-17-powered DC-9 aircraft showed a reduction in jet noise of 2.0 PNdB at static takeoff power with an attendant 0.3 percent improvement in fuel consumption. A second mixer configuration, define on a preliminary basis for JT8D-powered 727 aircraft, demonstrated a 4.7 PNdB reduction in jet noise at takeoff power. However, a penalty of 1.3 percent in fuel consumption was incurred, and this, combined with an incompatibility in the reverse thrust mode, indicated that significant additional development work is required to demonstrate a viable configuration for 727 aircraft. Testing was also successful in demonstrating the structural integrity of the mixer. In addition, the presence of the mixer did not impart any adverse interactive effects on the stress levels of other engine components. GRA

N81-17092# Teledyne CAE, Toledo, Ohio.
MULTI-PLANE HIGH SPEED BALANCING TECHNIQUES AND THE USE OF A HIGH SPECIFIC STIFFNESS Ti-BORSIC MATERIAL FOR VIBRATION CONTROL
Glenn Hamburg and W. Pentek Wright-Patterson AFB, Ohio AFWAL Feb. 1980 116 p refs Prepared in cooperation with Mechanical Technology Inc.
(Contract F33615-79-C-2018; AF Proj. 3066)
(AD-A093122; TCAE-1701; AFWAL-TR-80-2056) Avail: NTIS HC A06/MF A01 CSCL 21/5

This report documents results of multi-plane high-speed balancing demonstration of a flexible rotor and a preliminary design analysis for a high specific stiffness composite material shaft. Both studies had as their objective the management of small turbofan engine low pressure shaft bending critical speeds. The prototype flexible rotor was successfully balanced through 3 critical speeds reaching a maximum of 28,000 rpm, which was 74% of the maximum intended rotor speed of 38,000 rpm. Balancing for operation above the 4th critical speed, which was predicted to occur at 33,000 rpm, was prevented due to a sub-synchronous rotor instability. Causes of the instability were attributed to the configuration of the squeeze film bearing damper and the engine rotor support structure as opposed to any limitation of the balancing techniques employed. The preliminary composite shaft design was completed assuming that a Ti-Borsic metal matrix composite with 60% fiber volume and 40% metal matrix would be used. This 'stiff' shaft was designed as a direct substitute for the multi-plane high speed balancing demonstrator rotor. Analytical studies indicate that the composite rotor will have a 24% third critical speed margin when operating at 38,00 rpm. GRA

N81-17093# General Electric Co., Lynn, Mass. Aircraft Engine Group.
HIGH BYPASS TURBOFAN COMPONENT DEVELOPMENT, MODIFICATION 2 Final Report, Aug. - Nov. 1979
G. W. Armstrong, J. A. Palladino, and L. I. Zirin Wright-Patterson AFB, Ohio AFWAL Mar. 1980 94 p
(Contract F33615-78-C-2060; AF Proj. 3066)
(AD-A093156; AFWAL-TR-80-2032) Avail: NTIS HC A05/MF A01 CSCL 21/5

The assembly, instrumentation, and test of a fan shaft dynamics simulation vehicle was completed under this contract. Testing included low speed mechanical checkout, followed by operation up to 45,000 RPM using high speed model balancing,

as required. The procedure was repeated for two sets of bearing support stiffness values. Balance sensitivity of the rotor system was investigated by creating various amounts of unbalance in the fan disk, the turbine disk, and the shaft, and recording the vibratory response up to 45,000 RPM. Finally, a ten hour endurance test was conducted, completing the requirements of the contract. GRA

N81-17094# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
PREDICTION AND EVALUATION OF THRUST AUGMENTING EJECTOR PERFORMANCE AT THE CONCEPTUAL DESIGN STAGE Final Report, Oct. 1978 - Sep. 1978
K. A. Green 30 Apr. 1980 59 p refs
(WF41400000)
(AD-A093953; NADC-80094-60) Avail: NTIS HC A04/MF A01 CSCL 21/5

The performance characteristics of thrust augmenting ejectors, based on a computerized one dimensional analysis technique, are shown. Various loss mechanisms within the ejector are described and the sensitivity of the ejector performance to these loss mechanisms are illustrated. Performance estimates have been made for several ejector configurations for which experimental data are available. Despite the assumptions that have to be made, in order that the problem be tractable for the one dimensional analysis, good agreement between the predicted and experimental values have been obtained. Other more complex (2D and 3D) codes have also been examined but were found to be expensive to run and in some cases limited in application. GRA

N81-17095# Systems Control, Inc., Palo Alto, Calif.
MULTIVARIABLE CONTROL SYNTHESIS PROGRAM: CONTROL ASPECTS OF THE F100 ALTITUDE DEMONSTRATION OF THE MULTIVARIABLE CONTROL SYSTEM Final Report, 1 Apr. 1978 - 31 Mar. 1979
Ronald L. Dehoff, Stephen Rock, W. Earl Hall, Jr., and Richard J. Adams Wright-Patterson AFB, Ohio AFWAL Mar. 1980 80 p refs
(Contract F33615-75-C-2053; AF Proj. 3066)
(AD-A093868; AFWAL-TR-80-2010) Avail: NTIS HC A05/MF A01 CSCL 21/5

This report describes the engine test demonstration phase of the F100 multivariable control synthesis program. Details of the control system design procedure and results of the hybrid simulation tests are described in AFAPL-TR-77-35, Volumes 1 and 2. The analytical design of the F100 multivariable control system included a validation of the controller performance using a hybrid simulation. The hybrid simulation represented an 'average' F100 turbofan engine and assumed a one dimensional flow path. Of course, real engine test hardware, which includes the engine, sensing, and control actuator hardware, will behave differently. These differences are recognized by the control designers and, prior to extensive testing at critical design points, these differences and their impact on the controller performance must be quantified. This report describes the results of the activities to determine the base line engine and sensor/actuator hardware performance. The validation of the engine reference point and trim schedules are included. An analysis of the Delta P/P (Fan exit Mach number) instrumentation, the response characteristics of the basic fuel delivery system, and the contributions due to the response rate of the test facility are presented. GRA

N81-17096# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes (France).
MATERIAL AND STRUCTURAL PROBLEMS IN AIRCRAFT ENGINE TECHNOLOGY [PROBLEMES NOUVEAUX DE MATERIAUX ET DE STRUCTURE DANS LA TECHNOLOGIE DES MOTEURS D'AVIONS]
J. F. Chevalier Paris Association Aeronautique et Astronautique de France 1979 24 p In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979
(AAAF-NT-79-23; ISBN-2-7170-0571-4) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27

Citing the CFM-56 turbofan engine as an example, the development and improvement of jet aircraft engine structures and materials is discussed. Increasing engine operating temperature in order to diminish developing better high temperature alloys, and dimensioning of blades by photoelastic methods are treated. Metallurgical problems related to casting, forging, and machining of materials in other engine parts is also suggested. Author (ESA)

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N81-17097*# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
ACTIVE CONTROLS FOR FLUTTER SUPPRESSION AND GUST ALLEVIATION IN SUPERSONIC AIRCRAFT Final Report
E. Nissim Nov. 1980 269 p refs
(Grant NsG-7373)
(NASA-CR-163934) Avail: NTIS HC A12/MF A01 CSCL 01C

Results of work done on active controls on the modified YF-17 flutter model are summarized. The basic derivation of a suitable control law is discussed. It is shown that discrepencies found between analysis and wind tunnel tests originate from the lack of proper implementation of the desired control law. Program capabilities are described. A.R.H.

N81-17098# Committee on Science and Technology (U. S. House).
SPIN RECOVERY TRAINING
Washington GPO 1980 242 p refs Hearings before the Subcomm. on Invest. and Oversight of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 172, 17-19 1980
(GPO-67-439) Avail: Subcommittee on Investigations and Oversight

Regulations for licensing of private aircraft pilots are discussed. The major area of focus is on spin recovery training and whether it contributes significantly to flight safety. Statistical and economical analyses are presented. The FAA substitute pilot stall awareness program is described. T.M.

N81-17099# Naval Postgraduate School, Monterey, Calif.
A STUDY OF STATE FEEDBACK IMPLICIT MODEL FOLLOWING CONTROL FOR VSTOL AIRCRAFT M.S. Thesis
Lawrence Ernest Epley Sep. 1980 158 p refs
(AD-A093253) Avail: NTIS HC A08/MF A01 CSCL 01/4

The State Rate Feedback Implicit Model Follower control concept is examined in detail from a classical and modern control theory viewpoint. State Rate Feedback Implicit Model Following (SRFIMF) is a concept whereby control of the dynamic response of a system is achieved by the measurement and feedback of a state rate, normally acceleration. In addition to a basic description of the concept, emphasis is placed on the effect of noise in the measurement of the required feedback quantities. Control of the pitch attitude of the AV-8A Harrier VTOL aircraft is used as an example of the application of the control concept. The model of the Harrier used in this study includes the effect of both sensor measurement errors and gust load inputs. GRA

N81-17100# Bell Helicopter Co., Fort Worth, Tex.
FAULT-TOLERANT ACTUATION CONCEPT FOR A RESEARCH TEST AIRCRAFT Final Report, Sep. 1979 - Jul. 1980
Delbert E. Haskins Oct. 1980 99 p
(Contract N62269-79-C-0292)
(AD-A093113; NADC-79125-60) Avail: NTIS HC A05/MF A01 CSCL 13/7

The fault-tolerant actuation system uses 4 active electrical control paths to control a dualized hydraulic actuator. A simple failure management system operates in conjunction with some of the inherent features of the basic system to provide a failure tolerance level of dual fail-operate for the electrical control paths. The concept is characterized by its fundamental simplicity and

inherent ability to tolerate failures. The concept has application to fixed wing as well as rotary wing aircraft. GRA

N81-17101# Auburn Univ., Ala. Engineering Experiment Station.
AUTOMATIC HANDOFF OF MULTIPLE TARGETS Final Technical Report, 18 Dec. 1979 - 30 Sep. 1980
J. S. Boland, III and H. S. Ranganath 30 Sep. 1980 118 p refs
(Contract DAAH01-80-C-0258)
(AD-A093483; AD-E950071) Avail: NTIS HC A06/MF A01 CSCL 17/5

In order to fully utilize the potential of the 'fire and forget' class of helicopter-borne missiles, it is necessary to solve the technical problems associated with acquiring and handing off multiple targets from a precision pointing and tracking system (PTS) to several missile seekers simultaneously or almost so in a short period of time. The multiple target problem is that of locating targets and missile seeker aim points within the PTS field of view, deciding which target is to be assigned to each missile, generating error signals to the torquers in order to slew the missile LOS such that its assigned target is in the center of its FOV, and initiating automatic seeker tracking. The task of locating a given smaller image within a larger image is known as 'image registration'. A detailed comparison of the important multiple image registration methods based on the number of arithmetic operations for software implementation and the complexity of hardware for real time implementation is presented. New methods of accomplishing multiple image registration which are computationally more efficient than the most commonly used template matching techniques (correlation and sequential similarity detection algorithm) are described. Conclusions and recommendations are given. GRA

N81-17102# Engins Matra, Velizy (France).
AUTO-ADAPTIVE PILOTING [PILOTAGE AUTO-ADAPTATIF]
Yves Wesse, ed. and Alain Pechon, ed. Jul. 1978 124 p refs In FRENCH; ENGLISH summary
(GA-380) Avail: NTIS HC A06/MF A01

An auto-adpative numerical pilot for tactical missiles, primarily ground-to-air and air-to-air, is defined to assure the functions of stabilization and guidance over a wide range of dynamic pressure values. A simplified mathematical model of a finned missile and its pilot is given and was programmed on an IBM 370-158 computer. Simulation results are used to tune a system of differential equations evolving in hyperspace (dynamic parameters) which describes the servo control loops. Analysis of response to changes in dynamic pressure in fact shows the importance of this parameter and simulation results are given for extreme (high and low pressure) flight conditions.
Author (ESA)

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N81-17103# Shaker Research Corp., Ballston Lake, N. Y.
COMPRESSOR BLADE MONITORING SYSTEM FOR A VA1310 (ALLIS CHALMERS) WIND TUNNEL COMPRESSOR Final Report, Jul. 1979 - May 1980
Donald S. Wilson and John F. Frarey Jul. 1980 58 p refs
(Contract F33615-79-C-3019; AF Proj. 2414)
(AD-A092920; AFWAL-TR-80-3072) Avail: NTIS HC A04/MF A01 CSCL 21/5

The purpose of the work summarized in this report is to identify and develop a cost effective, reliable procedure for identifying potential blade failures in time to prevent the actual occurrence. The procedure is developed for application to an Allis-Chalmers ten-stage, axial flow compressor, Model VA 1310. The approach followed in conducting this study included a review of the current techniques used to insure blade integrity, a review of other approaches as described in literature for verifying the condition of compressor blades and, finally, development of a technique suitable for use with the VA 1310 compressor. GRA

N81-17104# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
WIND TUNNEL WALL INTERFERENCE Interim Report, 1 Apr. 1979 - 31 May 1980
D. B. Bliss Nov. 1980 25 p refs
(Grant AF-AFOSR-3337-77; AF Proj. 2307)
(AD-A093301; AFOSR-80-1359TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

The previous analysis of the aerodynamics of an isolated slender slot in a wall has been extended to include the effect of a streamwise pressure gradient. For certain slot planforms, an analytical solution is available for the case of a linear pressure gradient. The effect of aerodynamic interference for a single infinite row of slots was also studied. Solutions were obtained numerically for various Mach numbers, slot spacings, and aspect ratios. The effect of interaction between slots was to increase the slot flow rate for a given pressure differential. A wavy wall problem was posed to study the proper method of obtaining an average wall boundary condition given the behavior of individual holes or performations. This problem contains all the important physics and allows the basic parameters to be controlled in such a way that the important efforts can be clearly identified. Due to computational difficulties, the solution is being reformulated in a more efficient and useful form. However, preliminary calculations with the original approach did show that the boundary condition should be constructed differently for subsonic and supersonic flows, and that there are effects of pressure gradient and hole location become apparent as the pressure field wavelength is decreased. Some work was also done on isolated slot aerodynamics with large free surface displacement and on the compliant wall wind tunnel concept. GRA

N81-17105# ARO, Inc., Arnold Air Force Station, Tenn.
LASER SCATTERING APPLICATIONS DEVELOPMENT TEST IN AEDC TUNNEL B AT MACH NUMBER 8 Final Report, 16 Jan. 1980 - 12 Feb. 1980
W. T. Strike and L. L. Price AEDC Mar. 1980 51 p refs Sponsored by AF
(AD-A093929; AEDC-TSR-80-V16) Avail: NTIS HC A04/MF A01 CSCL 14/2

Free stream and local flow field measurements on a blunt (0.375 in. radius) nose 5 deg cone were made in Tunnel B at Mach number 8. The nonintrusive flow field measurements were made using various laser scattering optical systems to determine the free stream and local flow field particulate concentration and size distribution, the nitrogen molecule number density, and the local stream velocity using a Fabry-Perot interferometer system. The 5 deg cone pressure distributions were used to confirm the test section Mach number and to produce a known local flow field which could be used to demonstrate potentially useful laser scattering measuring techniques. GRA

N81-17106# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF THE ACOUSTIC AND AERODYNAMIC CHARACTERISTICS OF SEVERAL SLOT-BAFFLE CONFIGURATIONS FOR TRANSONIC WIND TUNNEL WALLS Final Report, 20 Oct. - 16 Nov. 1978
J. L. Jacocks, D. W. Sinclair, and R. L. Parker AEDC Jan. 1981 51 p refs Sponsored by AF
(AD-A093957; AEDC-TR-79-59) Avail: NTIS HC A04/MF A01 CSCL 14/2

An experimental investigation was conducted to record the acoustic and aerodynamic performance of several slotted walls with transverse baffles in the slots for transonic test sections. Primary configuration variables were the baffle angle inclination relative to the airstream and a wire mesh screen on the airside wall surface. At all baffle angles, the addition of the screen overlay decreased the acoustic noise level and improved the flow generation and supersonic wave cancellation properties of the wall but increased the subsonic wall interference effects.
GRA

N81-17107# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
EVALUATION OF A SUBSONIC CASCADE WIND TUNNEL FOR COMPRESSOR BLADE TESTING M.S. Thesis
David A. DuVal Sep. 1980 87 p refs
(AD-A093591) Avail: NTIS HC A05/MF A01 CSCL 20/4

Development of the subsonic cascade wind tunnel facility required determination of the two dimensionality and periodicity of the airflow in the test section with test cascade installed. Data acquisition procedures were developed and data were recorded for two facility configurations. The flow was shown to be unsatisfactory at a diffusion factor of approximately 0.58 and aspect ratio 1.25, and to be acceptably two dimensional and periodic at a diffusion factor of approximately 0.39 and aspect ratio 1.95. GRA

N81-17108# Lille Univ. (France). Inst. de Mecanique des Fluides.
A ROTATING, WIND TUNNEL BALANCE AND ASSOCIATED EXPERIMENTAL TECHNIQUES [BALANCE ROTATIVE DE L'INSTITUT DE MECANIQUE DES FLUIDES DE LILLE ET TECHNIQUES EXPERIMENTALES ASSOCIEES]
R. Verbrugge Paris Association Aeronautique et Astronautique de France 1980 52 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-13; ISBN-2-7170-0609-5) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Aerodynamic phenomena at steep angles of incidence associated with large amplitude movements incorporating continuous rotation are discussed in terms of coupling effects, generally nonlinear, necessary to formulating equations of motion. A rotating wind tunnel balance adapted to the similation of these flight conditions is described. Steep attack angle flight leading to loss of control and stalling regimes relative to aircraft spin were studied. Results obtained with a Mirage type aircraft model are shown. Author (ESA)

N81-17109# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
FIRST RESULTS OBTAINED WITH A ROTATING CONSTRUCTION [PREMIERS RESULTATS OBTENUS PAR LA SOCIETE AVIONS MARCEL DASSAULT-BREGUET AVIATION SUR LE MONTAGE TOURNANT DE L'INSTITUT DE MECANIQUE DES FLUIDES, LILLE]
C. Couedor Paris Association Aeronautique et Astronautique de France 1980 22 p In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979
(AAAF-NT-80-14; ISBN-2-7170-0610-9) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

A rotating wind tunnel balance used to study the behavior of aircraft flying at steep angles of attack is described. A particular study carried out on a model of a Mirage type fighter plane, characterized by its delta wing design, is reported on. Measurement signal acquisition and processing are covered. Flight characteristics for both the model stationary and in motion were defined and the significance of these data is discussed. Author (ESA)

N81-17110# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
FORMATION TRACKING. PART 2: TRACKING AND CONTROL PROCEDURES
G. Binias Apr. 1979 75 p refs In GERMAN; ENGLISH summary
(FFM-279-Pt-2) Avail: NTIS HC A04/MF A01

Tracking procedures based on a formation track initiation procedure are described and compared to single target tracking. Formation tracking is shown to be a collectivizing method of target data processing aimed at the control of the mean cinematic behavior of the formation targets and the control of a distinguished group of marginal targets which support the formation track in computer controlled target tracking. The control procedures enable the system to detect configuration variations in the formation and initiate branchings of formation tracks or junctions of formation tracks with other tracks in response. In order to comprehend the influence of maneuvers by the entire formation, control variables are determined in a central track oriented coordinate system. Simulation results are presented which demonstrate the effectiveness of these tracking and control procedures. Author (ESA)

N81-17111# Environmental Monitoring and Support Lab., Cincinnati, Ohio. Instrumentation Development Branch.
THERMAL ANALYSIS OF THE MANNING S-4000 PORTABLE WASTEWATER SAMPLER
Philip C. L. Lin Oct. 1980 44 p refs
(PB81-111858; EPA-600/4-80-045) Avail: NTIS HC A03/MF A01 CSCL 14B

The feasibility of mathematically designing a portable sampler with an ice compartment for the preservation of samples collected in sequence automatically at about 4C for a 24 hour period under certain environmental conditions, specifically 35C for both the ambient temperature and the samples was investigated. A Manning S-4000 sampler was selected. A mathematical model to simulate the sample cooling process was developed and experimental measurements on the sampler cooling system were conducted. Results indicated that about 80 to 96 percent of the cooling capacity of the sampler was lost to the surroundings. A modified cooling system is suggested. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N81-17150* Rockwell International Corp., Downey, Calif. Space Operations and Satellite Systems Div.
MULTIMISSION MODULAR SPACECRAFT IN-ORBIT REFUELING STUDY
F. G. Etheridge *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 43-57 refs (For primary document see N81-17145 08-23)
(Contract NAS5-26152)
CSCL 22A

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N81-17112 Texas Univ. at Austin.
PREDICTION OF THE EFFECTS OF UNADJUSTED PARAMETERS ON ORBITAL AND GEODYNAMICAL ESTIMATES Ph.D. Thesis
George Warren Botbyl 1980 167 p
Avail: Univ. Microfilms Order No. 8100876

The development of a parameter sensitivity analysis technique for use with both the batch and extended sequential estimators is described. Parameter sensitivity analysis as applied to orbit determination and tracking station coordinate estimates provides greater confidence in state vector estimates, allows for more detailed error analysis and is accomplished using only a single processing run. The parameter sensitivity analysis equations presented are general in nature and may be applied to study errors in such geodynamic parameters as tracking station coordinates, geopotential coefficients and the gravitational constant. To demonstrate the use of this sensitivity analysis technique primary emphasis was placed on studying the tracking station coordinates and in particular the effects caused by offset errors in the latitude of one of the tracking stations. Laser range observations of the Beacon Explorer-C satellite taken from two tracking stations were utilized in this study. Dissert. Abstr.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

No abstracts in this category.

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N81-17113*# General Electric Co., Philadelphia, Pa. Space Systems Div.
INTERNAL ELECTROSTATIC DISCHARGE HAZARD RISK ASSESSMENT TO THE GALILEO ORBITER ***Final Report***
R. E. Schmidt, J. C. Andrews, M. J. Treadaway (JAYCOR), and R. E. Leadon (JAYCOR) 27 Oct. 1980 40 p refs Prepared for JPL
(Contracts NAS7-100; JPL-955785)
(NASA-CR-163930) Avail: NTIS HC A03/MF A01 CSCL 22B

A worst case assessment was performed on the Command Data System (CDS) multilayer printed circuit board and an output power transformer module in the power subsystem. An estimate of the Jovian environment during the 35 hour orbit insertion was supplied by JPL and used as an input to calculate the electron transport into the Galileo components. A radiation shielding analysis computer code, CHARGE, calculated the electron transport deposition trapped in the anticipated sensitive areas of the multilayer board and transformer module. Based on these trapped charge calculations electric fields were calculated between the identified isolated areas and the spacecraft ground. The results of the assessment of electrostatic discharge (DSD) in the CDS multilayer printed circuit board indicate that the probability of ESD in the FR4 is low. The probability of ESD in the components attached to the multilayer board, however, is uncertain based on a lack of prior experimental data. T.M.

N81-17114# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SATNET DEVELOPMENT AND OPERATION. PLURIBUS SATELLITE IMP DEVELOPMENT. REMOTE SITE MAINTENANCE. INTERNET DEVELOPMENT: MOBILE ACCESS TERMINAL NETWORK, TCP FOR THE HP3000, TCP-TAC, TCP FOR VAX-UNIX **Combined Quarterly Technical Report, 1 Aug. - 31 Oct. 1980**
R. D. Bressler Nov. 1980 141 p refs
(Contracts MDA903-76-C-0252; N00039-78-C-0405; N00039-79-C-0386; MDA903-80-C-0353; *MDA903-80-C-0214; N00039-80-C-0664*)
(AD-A093164; BBN-4526; QTR-19) Avail: NTIS HC A07/MF A01 CSCL 22/2

This Quarterly Technical Report is the current edition in a series of reports which describe the work being performed at BBN in fulfillment of several ARPA work statements. This QTR *covers work on several ARPA-sponsored projects including* (1) development and operation of the SATNET satellite network; (2) development of the Pluribus Satellite IMP; (3) Remote Site *Maintenance activities; (4) inter-network monitoring;* (5) development of the Mobile Access Terminal Network; (6) TCP for the HP3000; (7) TCP-TAC; and (8) TCP for the VAX-UNIC. This *work is described in this single* Quarterly Technical Report with the permission of the Defense Advanced Research Projects Agency. The search for a mechanism for loading the UCL *gateway, once the ARPANET* trunking line via SATNET to the London TIP has been removed from service, has led to renewed interest in a gateway loading access path via SATNET directly. This requires a loader/dumper be written for the gateway which implements XNET4, Internet Protocol, Host-SATNET Protocol, and ARPANET VDH Protocol. Clearly, given the number of functions involved, it is essential that the implementation contain only minimal subsets of all protocols involved. GRA

N81-17115# RAND Corp., Santa Monica, Calif.
MEASURING THE IMPACT OF LAUNCH OPERATIONS UPON SATELLITE EFFECTIVENESS **Interim Report**
Bruce E. Krell Jun. 1980 68 p refs
(Contract F49620-77-C-0023)
(AD-A093744; RAND/N-1528-AF) Avail: NTIS HC A04/MF A01 CSCL 22/4

Procurement decisions regarding Department of Defense satellite systems are usually based upon the assumption of a reliable and dependable launch system. Attempts to relate disruptions of launch operations to numbers of satellites on-orbit are often in the form of discrete-event simulations (requiring significant numbers of data inputs and large amounts of computer time). The approach which is adopted in this study is a form of continuous simulation (as opposed to discrete-event simulation), an approach which has traditionally been limited to analysis of systems in the physical sciences. The continuous simulation methodology requires significantly fewer inputs than discrete-event simulations and is amenable to being implemented on a programmable, hand-held calculator, saving expensive computer and data-gathering time. Several examples are provided which demonstrate how continuous simulation may be used to model disruptions in launch capability and various satellite operational philosophies. GRA

N81-17116# Systems Research Labs., Inc., Dayton, Ohio.
SAM SYSTEM PERFORMANCE EVALUATION: E-O DATA FOR HUMAN OPERATOR MODEL DEVELOPMENT
Evan P. Rolek Nov. 1980 128 p refs
(Contract F33613-79-C-0500; AF Proj. 6893)
(AD-A094023; AFAMRL-TR-80-118) Avail: NTIS HC A07/MF A01 CSCL 17/7

A simulation experiment was performed to collect data on the performance characteristics of human operators tracking an aircraft using an electrooptical (TV) tracking system. Two teams were used in the study, each consisting of an azimuth tracker and an elevation tracker. The target aircraft's trajectory was one of five different flight profiles. Performance metrics consisted of angular tracking error in azimuth and elevation. Analysis of variance and Tukey tests were the primary statistical analysis techniques. All tracking errors were relatively low but statistical significance was obtained for trajectory differences, team differences, session effects, and team by session interactions. These data will be used to develop models of the human operators to be included in attrition models such as TAC ZINGER. In this way, Air Force researchers and strategists will be able to obtain engagement data, such as miss-distance and P_K when the threat system is operating in manual modes in addition to the automatic modes currently included in these models. GRA

N81-17117# General Systems Group, Inc., Salem, N.H.
REVIEW OF THE FIRE CONTROL SYSTEM **Final Report, 1 Jun. 1979 - 30 Sep. 1980**
18 Nov. 1970 141 p refs
(Contract N00014-80-C-0104)
(AD-A092887; GSG0001Z) Avail: NTIS HC A07/MF A01 CSCL 19/5

This report documents a series of studies that GSG, Inc. has performed on the Fire Control System (FCS). The major purpose of our activity was to formulate a set of recommendations on how to best evolve the FCS in light of its present characteristics and the perceptions available of the forthcoming new applications or enhancements of old applications. The method followed in pursuing the above stated goal was to, first of all, become entirely familiar with the technical/design documentation of the FCS Computer System. Studies were examined all available that characterized enhanced applications for the FCS and extrapolated information processing requirements. The latter was examined in a very critical way to determine the soundness of the basic assumptions leading to figures for throughput, and other information processing requirements. Having done that, and considering the characteristics of the architecture of the FCS,

the weak spots of the architecture, were determined in light of the new applications, and a series of moves recommended that could improve it to the point of handling the projected workload. GRA

N81-17118# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Qualite-Fiabilite.

STUDY OF THE OPERATIONAL AVAILABILITY OF THE METEOSAT SYSTEM Final Report [ETUDE DE DISPONIBILITE DU SYSTEME METEOSAT OPERATIONNEL]

Chemali, Affholder, Gadoin, and Pircher 13 Jun. 1980 51 p In FRENCH; ENGLISH summary

(CNES-CT/PRT/QPE/QF/159) Avail: NTIS HC A04/MF A01

Operational systems availability to users of the METEOSAT satellite facility was studied statistically. The system is composed of five satellites, launched at fixed dates and having a limited lifetime. The probability density of success for each phase of a satellite mission is determined based on a Markov process representation of failure. The method of satellite systems parameter simulation is explained. Results are used to establish and optimal launch schedule. Author (ESA)

N81-17119# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Thermique.

SATELLITE THERMAL CONTROL. COMPARISON OF VACUUM SOLAR SIMULATOR AND INFRARED TESTS: A PROGRAM OF INVESTIGATIONS INTO INFRARED TESTS [LE CONTROLE THERMIQUE DES SATELLITES. COMPARISON DES ESSAIS VIDE-SOLEIL ET INFRA-ROUGE. PROGRAMME D'ETUDES SUR LES ESSAIS INFRA-ROUGE]

A. Rolfo 30 Jun. 1980 24 p In FRENCH; ENGLISH summary

(CNES-80/CT/PRT/SST/TH/200) Avail: NTIS HC A02/MF A01

Satellite thermal control is briefly discussed, emphasizing design considerations. Thermal models, modeling errors, and obtainable precision of prediction results are covered. The importance of thermal control testing is pointed out. Solar simulator vacuum testing is juxtaposed with IR testing and compared for costs as well as reliability of results. American test philosophy is also compared to European philosophy. Results show the superiority of solar simulator testing, in spite of heavier initial investment, mainly due to a better return in spacecraft reliability. Author (ESA)

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N81-17120# ARO, Inc., Arnold Air Force Station, Tenn.

MATERIALS TESTS OF SPACE SHUTTLE ALTERNATE *FOAMS AND PROTUBERANCE DEBRIS MODELS* Final Report, Aug. 1979 - Jun. 1980

Gerald L. Dommerman AEDC Jun. 1980 106 p refs Sponsored by Air Force

(AD-A093310; AEDC-TSR-80-V31) Avail: NTIS HC A06/MF A01 CSCL 22/2

Wind tunnel tests of Space Shuttle insulating materials were conducted in the von Karman Gas Dynamics Facility Tunnels A and C. The tests were conducted to determine whether any significant insulation debris would be produced from insulation-covered protuberances during launch and to evaluate the insulating capabilities and erosion characteristics of several alternate insulating foams. The material samples were tested using the wedge technique. Test conditions were representative of those expected during launch. Selected results are presented to illustrate the test techniques, photographic coverage, and typical data obtained. GRA

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

N81-17121# TRW Defense and Space Systems Group, Redondo Beach, Calif.

DSCS 2 SATELLITE 9444 TELEMETRY TRANSMITTER ANOMALY REPORT Final Report

G. E. Neuner Aug. 1980 100 p refs

(Contract F04701-80-C-0022)

(AD-A093024; TRW-36060-AR-022-01; SD-TR-80-69) Avail: NTIS HC A05/MF A01 CSCL 09/6

The satellite was launched November 21, 1979, and was in transit toward 5W longitude (East Atlantic Ocean). No unusual telemetry, tracking and command subsystem conditions or other satellite anomalies were noted during the two months of orbital operation. An orbital anomaly investigation team was formed to: (1) determine possible failure causes, (2) investigate unit and part test histories, (3) examine telemetry and test correlations which might give clues to the cause of failure, and (4) compare with similar failures on Flight 4 and the Defense Space Program (DSP). After an exhaustive analysis and investigation, no definitive cause of failure could be found. Transmitter ground test history and orbital performance were normal prior to the failure. Possibly a random electronic part failure, such as an open or short in a diode or transistor, caused the failure; however, there is no evidence for suspecting any particular part. Other possibilities include an open circuit in a connector, wiring or printed circuit board trace, but it is unlikely these would have escaped detection during ground testing. No valid reason to suspect any specific failure mode is evident from the information available. GRA

N81-17122# Graz Univ. (Austria). Inst. fuer Nachrichtentechnik und Wellenausbreitung.

BASIC UNIT FOR REAL TIME DISPLAY OF PCM DATA [BODENGERAET ZUR ZEITECHTEN ANZEIGE VON PCM-DATEN]

R. Schmidt, N. Valavenoglou, E. Ofner, and O. Koudelka May 1979 58 p In GERMAN; ENGLISH summary

(INW-7905) Avail: NTIS HC A04/MF A01

A real-time video display microprocessor unit, handling the data flow from balloon-borne pressure and temperature sondes, is described. The digital system is based on PCM telemetry and can be used for any frame which uses multiples of eight bits. Microswitch adjustments for sync-word and frame length are included. There is no parity bit foreseen in the design, but slight modifications in hardware and software allow the use of 9 bit structures (8 bit data + parity). Author (ESA)

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N81-17123# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.

ROLL RESONANCE CONTROL OF ANGLE OF ATTACK FOR *REENTRY VEHICLE DRAG MODULATION* Interim Report

D.H. Platus 10 Dec. 1980 29 p refs

(Contracts F04701-80-C-0081; F04701-79-C-0080)

(AD-A093741; TR-0081(6940-02)-4; SD-TR-80-84) Avail: NTIS HC A03/MF A01 CSCL 20/4

Slender ballistic reentry vehicles are highly susceptible to roll rate changes caused by small asymmetries in mass and configuration. One particular combination of asymmetries, consisting of a body-fixed trim angle of attack and a small radial c.g. offset can cause a rapid spinup into resonance, with a large amplification in trim angle of attack and a concomitant increase in drag. By controlling the magnitude and direction of the c.g. offset with a moving-mass roll control system, it is possible to control the roll rate near resonance and to limit the angle-of-attack and drag response to a controlled value. A feedback law is derived, and the control system is demonstrated with a digital-computer simulation of the equations of rotational motion. GRA

N81-17124# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.

IONIZATION AND ATTRACTION OF NEUTRAL MOLECULES TO A CHARGED SPACECRAFT *Interim Report*

David P. Cauffman 1 Dec. 1980 39 p refs Updates SAMSO-TR-73-263 and TR-0074(9260-09)-1

(Contract F04701-80-C-0081)

(AD-A093287; TR-0081(6960-06)-2; SD-TR-80-78; SAMSO-TR-73-263; TR-0074(9260-09)-1) Avail: NTIS HC A03/MF A01 CSCL 22/2

Neutral molecules given off by spacecraft outgassing or thrusters may become ionized by solar UV radiation or ambient energetic electrons. These ions may be reattracted to the spacecraft and hence constitute a source of contamination for sensitive spacecraft surfaces. In this report, the magnitude of this effect is calculated. Comparable fluxes of ions are found to be produced by uv radiation and by electrons. It is predicted that 0.02 percent of the heavy neutral spacecraft effluents will be ionized within the spacecraft plasma sheath, and all of these will be returned to a negatively charged spacecraft. Using the best available outgas fluxes, it is also predicted that the reattraction of outgas products will be a significant contaminating effect during the initial several months of the spacecraft's orbital lifetime, second only to direct contaminant impingement. Together these effects deposited 100 A of contaminants in the first 6 months. The ionization/reattraction mechanism cannot be ruled out on the basis of present data. The implications of assuming that this contamination mechanism is the dominant one during the early spacecraft lifetime are examined. In addition, a list of parameters that need to be measured more accurately is presented, and ways to combat contamination from this source are outlined. GRA

N81-17125# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Thermique.

MODELING OF IN-SPACE CONTAMINATION. PRELIMINARY STUDY: EXAMPLES OF APPLICATION [MODELISATION DE LA CONTAMINATION SPATIALE. ETUDE PRELIMINAIRE: EXEMPLE D'APPLICATION]

B. Tatry 8 Jun. 1978 79 p In FRENCH; ENGLISH summary (CNES-78/CT/PRT/SST/TH/132) Avail: NTIS HC A05/MF A01

The theoretical calculation of spacecraft self-contamination is undertaken. Two fundamental parameters which characterize contamination are defined: (1) the thickness and the nature of deposits likely to form on a spacecraft surface and their evolution in function of time; and (2) the contaminating cloud, i.e., the particle density found at any its evolution in function of time. Mechanisms governing particle transfer and surface reactions with particles are hypothesized, based on results obtained onboard SKYLAB. A CDC 7600 Computer program which models contamination is presented and applied to the self-contamination of the SPOT satellite. Although the program is necessarily simplified, results show its potential for predicting contaminant deposition on spacecraft surfaces. Author (ESA)

N81-17126# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Thermique.

SIRIO 2: MODELING CONTAMINATION OF THE LASSO REFLECTOR. PRELIMINARY STUDY [ETUDE DE MODELISATION DE LA CONTAMINATION DU REFLECTEUR LASSO.]

B. Tatry 2 Apr. 1980 26 p In FRENCH; ENGLISH summary (CNES-80/CT/PRT/SST/TH/112) Avail: NTIS HC A03/MF A01

The self-contamination of the SIRIO 2 spacecraft was studied using a computer program which models contaminant sources and contaminant interaction with spacecraft surfaces. The SIRIO 2 spacecraft is equipped with laser reflectors for clock-sychronization; these reflectors are contaminant sensitive. Computer prediction results are seen as inconclusive, mainly due to uncertainty in physical values for outgassing (flux in function of time; surface redeposition rate). Nonetheless, a contamination problem is identified relative to satellite venting ports locates the reflectors. Author (ESA)

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N81-17127*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ENVIRONMENTAL CHARGING EFFECTS MONITORS FOR OPERATIONAL SATELLITES

John C. Sturman 1981 11 p refs Proposed for presentation at the 1981 Aerospace Ind./Test Meas. Symp., Sponsored by the Instr. Soc. of Am., Indianapolis, 26-30 Apr. 1981

(NASA-TM-81669; E-691) Avail: NTIS HC A02/MF A01 CSCL 22B

A set of three instruments was developed that can provide early detection of potentially dangerous geomagnetic substorm conditions, and monitor the spacecraft response. The set consists of three instruments: A Surface Voltage Sensor that measures the characteristic energy of collected electrons or ions from +100 to -20,000 volts; a logarithmic current density sensor or Nanoammeter that measures local electron flux by measuring currents from 10 to the minus 9th power to 10 to the minus 5th power A; and a Transient Events Counter that counts the spurious pulses from electrostatic discharges that are coupled into the spacecraft wiring harness. An amplitude threshold can be set to count only pulses that are large enough to cause circuit malfunction. Performance characteristics, specifications, and application of these instruments are discussed. Size, weight, and power requirements were minimized. The Surface Voltage Sensor and Nanoammeter are packaged together in a box that is 10.1 by 11.3 by 9.5 cm and weighs 0.82 kg. The transient Events Counter measures 10.1 by 11.3 by 5.4 cm and weighs 0.55 kg. Both operate from a nominal 28 V dc input and require a total of 3/4 watt for both. Although designed for flight use, these instruments are also suitable for laboratory use. T.M.

N81-17128# Utah State Univ., Logan.

THERMOSPHERIC DIAGNOSTICS USING IN SITU PROBING BY ELECTRON BEAM-INDUCED LUMINESCENCE Final Report, 30 Jun. 1978 - 31 Dec. 1979

W. R. Pendleton, Jr. Hanscom AFB, Mass. AFGL 30 Jan. 1980 74 p refs

(Contract F19628-78-C-0103; AF Proj. 2310)

(AD-A092942; AFGL-TR-80-0047) Avail: NTIS HC A04/MF A01 CSCL 07/4

The development of an electron-beam-induced-luminescence system, suitable for integration in the payload of an Astrobee F test vehicle is described. A modified Pierce-type electron gun is used in conjunction with a magnetic lens to provide a well defined 60 mA beam at 3.0 kV. The target emissions induced by the beam are spectrally selected and measured using a government furnished echelle spectrometer. Initial tests of the system are described. The development of auxiliary flight instrumentation is also documented. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N81-17129*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

EXPERIMENTAL AND ANALYTICAL EVALUATION OF ION THRUSTER/SPACECRAFT INTERACTIONS

M. Ralph Carruth, Jr., ed. 15 Jan. 1981 233 p *refs* (Contract NAS7-100)

(NASA-CR-163975; JPL-Pub-80-92) Avail: NTIS *HC A11/MF A01 CSCL 21C*

Studies were conducted to both identify the environment produced by ion thrusters and to assess the interaction of this *environment on a typical spacecraft and typical science instruments.* Spacecraft charging and the charge exchange that accompanies it is discussed in detail. Electromagnetic interfer*ence was characterized for ion engines. The electromagnetic* compatibility of ion thrusters with spacecraft instruments was determined. The effects of ion thruster plumes on spacecraft *were studied with particular emphasis on external surface currents.* For individual titles, see N81-17130 through N81-17139.

N81-17130*# *Jet Propulsion Lab., California Inst. of Tech.,* Pasadena.

SOLAR ARRAY/SPACECRAFT BIASING

D. J. Fitzgerald In its Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 11-28 (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

Biasing techniques and their application to the control of spacecraft potential is discussed. Normally when a spacecraft is *operated with ion thrusters, the spacecraft will be 10-20 volts* negative of the surrounding plasma. This will affect scientific measurements and will allow ions from the charge-exchange *plasma to bombard the spacecraft surfaces with a few tens of* volts of energy. This condition may not be tolerable. A proper bias system is described that can bring the spacecraft to or near the potential of the surrounding plasma. T.M.

N81-17131*# *Jet Propulsion Lab., California Inst. of Tech.,* Pasadena.

CHARGE-EXCHANGE PLASMA ENVIRONMENT FOR AN *ION DRIVE SPACECRAFT*

Harold R. Kaufman (Colorado State Univ.) and M. Ralph Carruth, Jr. In its Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft *Interactions 15 Jan. 1981 p 29-66 refs (For primary document* see N81-17129 08-20)

(JPL-Pub-79-90) Avail: NTIS HC A11/MF A01 CSCL 21C

A model was reviewed which describes the propagation of the mercury charge-exchange plasma and extended to describe the flow of the molybdenum component of the charge-exchange *plasma. The uncertainties in the models for various conditions* are discussed. Such topics as current drain to the solar array, charge-exchange plasma material deposition, and the *effects of space plasma on the charge-exchange plasma propagation are* addressed. T.M.

N81-17132*# *Jet Propulsion Lab., California Inst. of Tech.,* Pasadena.

PROPAGATION OF CHARGE-EXCHANGE PLASMA PRODUCED BY AN ION THRUSTER

M. Ralph Carruth, Jr. and M. E. Brady (Boeing Aerospace Co., *Pasadena, Calif.) In its Exptl. and Anal. Evaluation of Ion* Thruster/Spacecraft Interactions 15 Jan. 1981 p 67-72 refs (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

Under the proper conditions there is an end-effect of a long, cylindrical Langmuir probe which allows a significant increase in *collected ion current when the probe is aligned with a flowing* plasma. This effect was used to determine the charge-exchange plasma flow direction at various locations relative to the ion *thruster. The ion current collected by the probe as a function of* its angle with respect to the plasma flow allows determination of the plasma density and plasma flow velocity at the probe's *location upstream of the ion thruster optics. The density values* obtained from the ion current agreed to within a factor of two of density values obtained by typical voltage-current Langmuir probe characteristics. T.M.

N81-17133*# Jet Propulsion Lab., California Inst. of Tech., *Pasadena.*

COMPUTER CODE FOR CHARGE-EXCHANGE PLASMA PROPAGATION

Raymond S. Robinson and Harold R. Kaufman In its Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 73-145 (For primary document see N81-17129 08-20) *(Contract JPL-955322)*

Avail: NTIS HC A11/MF A01 CSCL 21C

The propagation of the charge-exchange plasma *from an electrostatic ion thruster is crucial in determining the interaction* of that plasma with the associated spacecraft. A model that describes this plasma and its propagation is described, together with a computer code based on this model. The structure and calling sequence of the code, named PLASIM, is described. An explanation of the program's input and output is included, together with samples of both. The code is written in ASNI Standard FORTRAN. Author

N81-17134*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FACILITY PRODUCED CHARGE-EXCHANGE IONS

M. Ralph Carruth, Jr. *In its* Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 147-166 *refs (For primary document see N81-17129 08-20)*

Avail: NTIS HC A11/MF A01 CSCL 21C

These facility produced ions are created by charge-exchange *collisions between neutral atoms and energetic thruster beam* ions. The result of the electron transfer is an energetic neutral atom and an ion of only thermal energy. There are true *charge-exchange ions produced by collisions with neutrals* escaping from the ion thruster and being charge-exchange ionized before the neutral intercepts the tank wall. The facility *produced charge-exchange ions will not exist in space and* therefore, represent a source of error where measurements involving ion thruster plasmas and their density are involved. *The quantity of facility produced ions in a test chamber with a* 30 cm mercury ion thruster was determined. T.M.

N81-17135*# *Jet Propulsion Lab., California Inst. of Tech.,* Pasadena.

RADIATED AND CONDUCTED EMI FROM A 30-cm ION THRUSTER

A. C. Whittlesey and W. Peer In its Exptl. and Anal. Evaluation *of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 167-183* (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

In order to properly assess the interaction of a spacecraft with the EMI environment produced by an ion thruster, the EMI environment was characterized. Therefore, radiated and conducted *emissions were measured from a 30-cm mercury ion thruster.* The ion thruster beam current varied from zero to 2.0 amperes and the emissions were measured from 5 KHz to 200 MHz. *Several different types of antennas were used to obtain the* measurements. The various measurements that were made included: magnetic field due to neutralizer/beam *current loop; radiated electric fields of thruster and plume; and* conducted emissions on arc discharge, neutralizer keeper and magnetic baffle lines. T.M.

N81-17138*# Jet Propulsion Lab., California Inst. of Tech., *Pasadena.*

ELECTROMAGNETIC INTERFERENCE ASSESSMENT OF AN ION DRIVE ELECTRIC PROPULSION SYSTEM

A. C. Whittlesey In its Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 185-190 refs (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

An electric propulsion thrust system has the capability of providing a high specific impulse for long duration scientific

missions in space. The EMI from the elements of an ion engine was characterized. The compatibility of ion drive electric propulsion systems with typical interplanetary spacecraft engineering was predicted. T.M.

N81-17137*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ION PLUME/S-BAND CARRIER INTERACTION STUDY

P. Stanton In its Exptl. and Anal. Evaluation of Ion Thruster/ Spacecraft Interactions 15 Jan. 1981 p 191-215 refs (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

A study was performed to determine the effects of a mercury ion thruster plume on an S-band telecommunication carrier. Experiments were carried out on a 30 cm thruster in a JPL test chamber. Results from simple analytical models were compared with the above measurements and major discrepancies were discovered. Modifications to the electron density model provided a qualitative explanation, but further work is necessary for a quantitative answer. The results indicate the effects of the plume, on S and X Band telecommunications will be minor, with the possible exception of critical angle blockage. T.M.

N81-17138*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

INTERACTIONS BETWEEN A SPACECRAFT AND AN ION THRUSTER PRODUCED ENVIRONMENT

M. Ralph Carruth, Jr. and E. V. Pawlik *In its* Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 217-229 refs Presented at the 14th Intern. Elec. Propulsion Conf., 1979 (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

The electron bombardment ion thruster is a candidate propulsion device for several proposed interplanetary missions. A comet rendezvous mission is expected to be the first use of a Solar Electric Propulsion System (SEPS). Because this is the first use of such a system, it is necessary to understand the interactions between the spacecraft and the environment produced by the SEPS. A preliminary assessment of the interactions between a thruster produced environment and the Comet Rendezvous spacecraft, including its science instruments, is presented which concludes that compatibility between the SEPS and the spacecraft can be obtained. T.M.

N81-17139*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ION THRUSTER PLUME EFFECTS ON SPACECRAFT SURFACES

M. Ralph Carruth, Jr. and Y. S. Kuo *In its* Exptl. and Anal. Evaluation of Ion Thruster/Spacecraft Interactions 15 Jan. 1981 p 231-241 refs (For primary document see N81-17129 08-20)

Avail: NTIS HC A11/MF A01 CSCL 21C

A charge-exchange plasma, generated by an ion thruster, is capable of flowing upstream from the ion thruster and therefore represents a source of contamination to a spacecraft. An analytical model of the charge-exchange plasma density around a spacecraft was used to estimate the contamination which various spacecraft materials may be exposed to. Measurements of plasma density around an ion thruster were compared to this model. Results of experimental studied regarding the effects on various spacecraft materials' properties due to exposure to expected mercury contamination levels are presented. T.M.

N81-17140*# Aerojet Liquid Rocket Co., Sacramento, Calif.

ORBIT TRANSFER VEHICLE (OTV) ENGINE STUDY, PHASE 'A' EXTENSION 2 Final Report, 6 Oct. 1980 - 5 Jan. 1981

K. L. Christensen 19 Jan. 1981 48 p refs

(Contract NAS8-32999)

(NASA-CR-161639; Rept-32999-F-E2) Avail: NTIS HC A03/MF A01 CSCL 21H

The operation of the Advanced Expander Cycle OTV engine was evaluated at high mixture ratios, and intermediate and low thrust levels to establish the impact upon the engine design and costs, and/or operating characteristics. The engine operation was analyzed at tank head and pumped idle conditions with the nozzle extension retracted. The engine performance, weight, and envelope parametrics data were expanded to include mixture ratios of 7.5 and 8.0. T.M.

N81-17141*# Aerojet Liquid Rocket Co., Sacramento, Calif.

ORBIT TRANSFER VEHICLE (OTV) ADVANCED EXPANDER CYCLE ENGINE POINT DESIGN STUDY. VOLUME 2: STUDY RESULTS Final Report

10 Dec. 1980 285 p refs

(Contract NAS8-33574)

(NASA-CR-161638; Rept-33574-F-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 21H

Detailed computer models of the engine were developed to predict both the steady state and transient operation of the engine system. Mechanical design layout drawings were prepared for the following components: thrust chamber and nozzle; extendible nozzle actuating mechanism and seal; LOX turbopump and boost pump; hydrogen turbopump and boost pump; and the propellant control valves. The necessary heat transfer, stress, fluid flow, dynamic, and performance analyses were performed to support the mechanical design. T.M.

N81-17142# Tennessee Univ. Space Inst., Tullahoma.

DEVELOPMENT OF A METHOD FOR PREDICTING TRAJECTORIES AND TERMINAL VELOCITIES OF BACKBLAST DEBRIS FROM SMALL ROCKETS Final Report, May 1979 - Aug. 1980

Rush E. Elkins and Dennis R. Keefer Dec. 1980 83 p refs

(Contracts DAAG29-79-C-0098; DAAG29-79-C-0127)

(AD-A093768; ARO-16711.1-A-E) Avail: NTIS HC A05/MF A01 CSCL 19/7

A semiempirical model is developed to predict debris hazard arising from the backblast of small rockets. The model is in three parts. Gas dynamics give upper bounds on maximum velocities of jet entrained particles. Aerodynamics give an expression for subsequent motion of debris through still air. A semiempirical study gives an expression describing skin penetration by debris. Computer codes are given for implementation of model. GRA

N81-17143# Kaman Avidyne, Burlington, Mass.

MEASUREMENTS OF BLAST PRESSURES ON A RIGID 35 DEG SWEPTBACK WING AT MACH 0.76 FROM ROCKET PROPELLED SLED TESTS Final Report, 1 Feb. 1979 - 1 Jan. 1980

Dale A. Kleppin, J. Ray Ruetenik, and Robert F. Smiley 31 Jan. 1980 433 p refs

(Contract DNA001-79-C-0157)

(AD-A093729; KA-TR-175; DNA-5211F) Avail: NTIS HC A19/MF A01 CSCL 20/4

Interaction of a blast wave with a 35 deg-sweepback wing model was measured in a series of two sled tests performed on the 50,788-ft sled tract at Holloman AFB in September 1979. The model was rigid and had a 5.6 aspect ratio and 0.42 taper ratio. The sled, travelling at Mach 0.76, was intercepted successively by blast waves produced from TNT charges. Blast-induced pressure differentials were measured at 20 locations on the wing. Shock overpressures ranged from 1.3 to 4.1 psi and intercept angles were 45, 90 and 135 degrees from head-on. This report describes the tests and presents the test results. Preliminary analysis of the test results indicates the existence of non-linear blast-induced airloads on the model at the lowest shock overpressure. GRA

N81-17144# Association Aeronautique et Astronautique de France, Paris.

COMPOSITE MATERIALS AND SOLID PROPELLANT PROPULSION [LES MATERIAUX NOUVEAUX DANS LA PROPULSION A PROPERGOL SOLIDE]

P. Lamicq 1979 8 p In FRENCH

(AAAF-NT-79-40; ISBN-2-7170-0588-9) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

The use of composite materials in place of metals to reduce the inert mass of upper stages in rockets is discussed. The MAGE apogee engine is cited as an example. Composite structures of KEVLAR fiber reinforced epoxy resin are described. Insulating qualities of elastomers used in solid propellant chamber linings

are noted. Laminates and carbon-carbon composites are also shown in engine component applications. Author (ESA)

N81-17147* *Jet Propulsion Lab., California Inst. of Tech.,* Pasadena.
FLUORINE/HYDRAZINE PROPULSION SYSTEM SAFETY CONSIDERATIONS FOR STS OPERATIONS
D. L. Bond, G. W. Kruger, and L. C. Montgomery *In* NASA, *Washington The 1980 JANNAF Propulsion Systems Hazards* Subcomm. Meeting, Vol. 1 Dec. 1980 p 7-19 refs (For primary document see N81-17145 08-23)
(Contract NAS7-100)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

N81-17148* TRW Defense and Space Systems Group, Redondo Beach, Calif.
SAFETY OF LIQUID PROPULSION SYSTEMS FOR STS PAYLOADS
J. C. Lewis and R. G. Gilroy *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 21-35 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

N81-17149* Air Force Space Div., Los Angeles, Calif.
LIQUID AND SOLID PROPULSION SYSTEM SAFETY DESIGN CRITERIA FOR SPACE TRANSPORTATION SYSTEM PAYLOADS
James S. Smith *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 37-41 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N81-17145* National Aeronautics and Space Administration, Washington, D. C.
THE 1980 JANNAF PROPULSION SYSTEMS HAZARDS SUBCOMMITTEE MEETING, VOL. 1
John A. E. Hannum, ed. Dec. 1980 377 p refs Conf. held at Naval Postgraduate School, Monterey, Calif., 29-31 Oct. 1980; Sponsored by Joint Army-Navy-NASA-Air Force (JANNAF) Prepared in cooperation with APL, Laurel, Md.
(Contract N00024-78-C-5384)
(CPIA-Pub-330-Vol-1; NASA-TM-82255) Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

A variety of hazards evaluation and hazards technology areas associated with propulsion systems are addressed. Space propulsion systems hazards, gun propulsion hazards, deflagration to detonation transition; shock to detonation transition, projectile impact hazards, propellant properties for dynamic interaction, and sympathetic reactions are discussed. For individual titles, see N81-17146 through N81-17166.

N81-17146* National Aeronautics and Space Administration, Washington, D. C.
SAFETY POLICY AND REQUIREMENTS FOR PAYLOADS USING THE SPACE TRANSPORTATION SYSTEM c06
P. D. Davis *In its* The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 1-6 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 22A

New safety requirements for payloads using the Space Transportation System are presented. Responsibility for assuring payload safety is placed on the payload organization. L.F.M.

N81-17147* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FLUORINE/HYDRAZINE PROPULSION SYSTEM SAFETY CONSIDERATIONS FOR STS OPERATIONS c20
D. L. Bond, G. W. Kruger, and L. C. Montgomery *In* NASA, *Washington The 1980 JANNAF Propulsion Systems Hazards* Subcomm. Meeting, Vol. 1 Dec. 1980 p 7-19 refs (For primary document see N81-17145 08-23)
(Contract NAS7-100)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

The design and safety constraints for a passive fluorine/hydrazine propulsion payload for the Space Transportation System *Orbiter are summarized and the details of the safety and technical* reviews completed for a prototype system are discussed. Considerations include thermal, materials, containment, fire, explosion, leakage, venting, ground support, abort return to Earth, reliability and all phases of test and operations. Author

N81-17148* TRW Defense and Space Systems Group, Redondo Beach, Calif.
SAFETY OF LIQUID PROPULSION SYSTEMS FOR STS PAYLOADS c20
J. C. Lewis and R. G. Gilroy *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 21-35 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

STS payload safety requirements for Earth-storable liquid propulsion systems are reviewed with respect to applicable safety documents. The effect of normal flight and emergency landing/abort launch profiles on propulsion system design is delineated. Spacecraft studied include Earth satellites, interplanetary spacecraft, and orbit transfer vehicles. Safety considerations for monopropellant (hydrazine), bipropellant (nitrogen tetroxide/monomethyl hydrazine), and ion (mercury) propulsion systems are described. Safety requirements for specific components of propulsion systems are reported. Analysis techniques for STS payload fracture control requirements for pressure vessels and critical support structure are discussed. Author

N81-17149* Air Force Space Div., Los Angeles, Calif.
LIQUID AND SOLID PROPULSION SYSTEM SAFETY DESIGN CRITERIA FOR SPACE TRANSPORTATION SYSTEM PAYLOADS c20
James S. Smith *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 37-41 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21H

Design safety criteria for Space Transportation System propulsion system payloads are discussed. Terms such as inhibit, monitoring, safing, safe distance, safe and arm device, and flow control device are defined and their use in design of safety requirements described. L.F.M.

N81-17150* Rockwell International Corp., Downey, Calif. Space Operations and Satellite Systems Div.
MULTIMISSION MODULAR SPACECRAFT IN-ORBIT REFUELING STUDY c12
F. G. Etheridge *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 43-57 refs (For primary document see N81-17145 08-23)
(Contract NAS5-26152)
CSCL 22A

The approaching operational status of the Space Transportation System (STS) means that on-orbit servicing/refurbishment of orbiting spacecraft will be possible. The issues are discussed and the options related to refueling the Multimission Modular Spacecraft (MMS) in the Shuttle cargo bay are identified. The larger MMS spacecraft, Mark 2, requires the transfer of 5000 pounds of hyrazine. Resupply tankage configuration, location in the Shuttle, propellant transfer methods, fluid coupling equipment, and safety-related items also are discussed. The equipment required to define an on-orbit system capable of refueling the MMS is identified. Author

N81-17151* Naval Weapons Center, China Lake, Calif.
JANNAF WORKSHOP ON HAZARDS DUE TO PRE-COMBUSTION BEHAVIOR OF HIGH ENERGY PROPELLANTS c25
T. L. Boggs *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 85-103 Conf. held at Eglin Air Force Base, 15-16 Apr. 1980 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

Experimental results and hazards associated with the pre-combustion behavior of high energy propellants are discussed. Special attention was given to future needs for modeling and the problem of deflagration to detonation transition. L.F.M.

N81-17152* Los Alamos Scientific Lab., N. Mex.
DEFLAGRATION-TO-DETONATION TRANSITION IN GRANULAR HMX c25
A. W. Campbell *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 105-130 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

Granular HMX of three degrees of fineness was packed into heavy-walled steel tubes closed at both ends. Ignition was obtained at one end using an intimate mixture of finely divided titanium and boron as an igniter that produced heat with little gas. The distance to detonation was determined by examination of the resulting tube fragments. By inserting tightly-fitted neoprene diaphragms periodically into the HMX column, it was shown that the role of convective combustion was limited to the initial stage of the deflagration to detonation (DDT) process. Experiments in which various combinations of two of the three types of HMX were loaded into the same tube showed that heating by adiabatic shear of explosive grains was an essential factor in the final buildup to detonation. A description of the DDT process is developed in which conductive burning is followed in turn by convective burning, bed collapse with plug formation, onset of accelerated burning at the front of the plug through heating by intercrystalline friction and adiabatic shear, and intense shock formation resulting in high-order detonation. Author

N81-17153* Illinois Univ. at Urbana-Champaign. Dept. of Aeronautical and Astronautical Engineering.
FLUID DYNAMICS OF THE UNSTEADY TWO PHASE PROCESSES LEADING TO DDT IN GRANULAR SOLID PROPELLANTS c25
H. Krier, P. B. Butler, and M. F. Lembeck *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 131-145 refs (For primary document see N81-17145 08-23)
(Grant AF-AFOSR-3336-77)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

Deflagration to Detonation (DDT) was predicted to occur in porous beds of high-energy solid propellants by solving the unsteady fluid mechanical convective heat transfer from hot gas products, obtained from the rapid burning at high pressures, provides the impetus to develop a narrow combustion zone and a resulting strong shock. A parametric study clearly indicates that DDT occurs only when a combination of the solids loading fraction, the burning rate constants, the propellant chemical energy, and the particle size provide for critical energy and gas release to support a detonation wave. Predictions for the run-up length to detonation as a function of these parameters are presented. Author

N81-17154* Naval Weapons Center, China Lake, Calif. Detonation Physics Div.
BURNING-TO-VIOLENT-REACTION TRANSITIONS IN EXPLOSIONS c25
K. J. Graham and R. G. S. Sewell *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 147-177 refs Sponsored by the Navy Air Strike Warfare Program (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

In a program to study fragment initiation of cased propellants and explosives, it was found that one area of extreme importance is that of the cased reactive-material burning reactions triggered by the perforation of the case by an impacting fragment. Once the reaction is started, the importance of the impactor decreases, and the sequence of events is controlled by the burning properties of the reactive material, its physical condition, and the nature of the confinement. A brief history of the results obtained by previous investigators is presented along with a discussion of variations in experimental results caused by geometrical changes in the test configurations. Changes in interpretations of the results are discussed. Results of recent confined-burn tests with Composition B, PBXC-116, PBXC-117, and Destex are presented, including results of metallurgical examination of the confined fragments. These examinations indicate a transition to a violent reaction which is not a detonation, although it produces many effects that resemble a detonation. Author

N81-17155* Naval Weapons Center, China Lake, Calif.
THE ROLE OF GAS PHASE REACTIONS IN THE DEFLAGRATION-TO-DETONATION TRANSITION OF HIGH ENERGY PROPELLANTS c25
T. L. Boggs, C. F. Price, A. I. Atwood, D. E. Zurn, J. L. Eisel, and R. L. Derr *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 179-201 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

The inadequacies of the two commonly used assumptions are shown, along with the need for considering gas phase reactions. Kinetic parameters that describe the gas phase reactions for several ingredients are provided, and the first steps in convective combustion leading to deflagration to detonation transition are described. L.F.M.

N81-17156* Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
EFFECT OF PROPELLANT DEFORMATION ON IGNITION AND COMBUSTION PROCESSES IN SOLID PROPELLANT CRACKS c25
M. Kumar and K. K. Kuo *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 203-238 refs (For primary document see N81-17145 08-23)
(Contract N00014-79-C-0762)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

A comprehensive theoretical model was formulated to study the development of convective burning in a solid propellant crack which continually deforms due to burning and pressure loading. In the theoretical model, the effect of interrelated structural deformation and combustion processes was taken into account by considering (1) transient, one dimensional mass, momentum, and energy conservation equations in the gas phase; (2) a transient, one dimensional heat conduction equation in the solid phase; and (3) quasi-static deformation of the two dimensional, linear viscoelastic propellant crack caused by pressure loading. Partial closures may generate substantial local pressure peaks along the crack, implying a strong coupling between chamber pressurization, crack combustion, and propellant deformation, especially when the cracks are narrow and the chamber pressurization rates high. The maximum pressure in the crack cavity is generally higher than that in the chamber. The initial flame-spreading process is not affected by propellant deformation. S.F.

N81-17157* Los Alamos Scientific Lab., N. Mex.
OBSERVATIONS OF LONG DELAYS TO DETONATION IN PROPELLANT FOR TESTS WITH MARGINAL CARD GAPS c25
Bart Olinger *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 239-244 ref (For primary document see N81-17145 08-23)
(Contract N00030-78-MD-78007)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

Using the large-scale card gap tests with pin and high-speed framing camera techniques, VRP propellant, and presumably

others, were found to transit to detonation at marginal gaps after a long delay. In addition, manganin-constantan gauge measurements were made in the card gap stack. S.F.

N81-17158* Hercules, Inc., Magna, Utah.
WHAT'S WRONG WITH THE NOL CARD GAP TEST? c28
Billings Brown *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 245-256 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The card gap test, originally developed for explosives, was adopted for determining the shock sensitivity of propellants. Testing solid propellants resulted in the discovery of several deficiencies in the test. The effects of critical diameter, donor pulse duration, and initiator variability are discussed. Reproducibility of results is shown to be worse for solid propellants than is reported for explosives. The calibration to express test results as shock pressure is of questionable accuracy. Use of the test in its present form leads to erroneous conclusions. Author

N81-17159* Naval Surface Weapons Center, White Oak, Md.
THE NOL GAP TEST: PAST, PRESENT, AND FUTURE c28
Sigmund J. Jacobs and Donna Price *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 257-265 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

A brief history of the development of the gap test is presented with emphasis on accumulated knowledge of how best to use it as a tool to assess relative shock sensitivity of explosives and propellants. Present information about the detonation process in build-up, steady state, and failure is used to show that failure diameter cannot give the desired shock sensitivity assessment. Suggestions are made for improving the test to an experiment. The use of spherical donors, water as attenuator, and camera instrumentation are briefly discussed. Author

N81-17160* Los Alamos Scientific Lab., N. Mex.
A NUMERICAL STUDY OF THE NOL LARGE-SCALE TEST c28
Allen L. Bowan *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 267-275 refs (For primary document see N81-17145 08-23)
(Contract N00030-79-MD-790009)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The large-scale gap test was modeled numerically using the reactive hydrodynamics code 2DE with forest fire burn rates. The model gives good agreement between calculated and experimental critical gap values. The calibration of peak pressure in the gap versus gap length is obtained from these calculations, and is in good agreement with the published experiment curve. The two dimensional nature of the gap test is evident from the curvature of the shock wave in the gap and test sample, and from the observed distance of run to detonation in the test samples. Author

N81-17161* Naval Surface Weapons Center, White Oak, Md.
SHOCK SENSITIVITY OF ENERGETIC MATERIALS c28
K. Kim *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 277-288 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Viscoplastic deformation is examined as the principal source of hot energy. Some shock sensitivity data on a proposed model is explained. A hollow sphere model is used to approximate complex porous matrix of energetic materials. Two pieces of shock sensitivity data are qualitatively compared with results of the proposed model. The first is the p2 tau law. The second is the desensitization of energetic materials by a ramp wave applied stress. An approach to improve the model based on experimental observations is outlined. S.F.

N81-17162* Naval Weapons Center, China Lake, Calif.
REPORT ON JANNAF PANEL ON SHOTGUN/RELATIVE QUICKNESS TESTING Progress Report c28
R. A. Gould *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 289-301 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

As the need for more energetic solid propellants continues, a number of problems arises. One of these is the tendency of high energy propellants to transition from burning (deflagration) to detonation in regions where the propellant is present in small particle sizes; e.g., in case bonding areas of a motor after a rapid depressurization causes a shear zone at the bond interface as the stressed propellant and motor case relax at different rates. In an effort to determine the susceptibility of propellants to high strain rate break up (friability), and subsequent DDT, the propulsion community uses the shotgun/relative quickness test as one of a number of screening tests for new propellant formulations. Efforts to standardize test techniques and equipment are described. S.F.

N81-17163* Los Alamos Scientific Lab., N. Mex.
NUMERICAL CALCULATION OF SHOCK-INDUCED INITIATION OF DETONATIONS c28
G. E. Cort and J. H. M. Fu *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 303-320 refs Supported by DOE (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

Results of numerical calculations of the impact of steel cylinders and spheres on the plastic bonded high explosive PBX 9501 are described. The calculations were carried out by a reactive, multicomponent, two dimensional, Eulerian hydrodynamic computer code, 2DE. The 2DE computer code is a finite difference code that uses the donor acceptor cell method to compute mixed cell fluxes. The parameters in the Forest Fire burn model are developed from experiments where the induced shock approximates a plane wave and are applied, in this case, to a situation where the induced shock is a divergent wave with curvature that depends on the size and shape of the projectile. The calculated results are compared with results from experiments involving instrumented mock and live high explosives, with projectiles of varying size, shapes, and velocities. S.F.

N81-17164* Southwest Research Inst., San Antonio, Tex.
PREDICTION OF INITIATION OF LOW AND HIGH EXPLOSIVE FILLERS DUE TO FRAGMENT OR PROJECTILE IMPACT c25
P. H. Zabel and V. B. Parr *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 321-333 refs Sponsored by AFSC (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

A methodology is tpresented which provides predictions for the probability of initiation of explosion in high explosive filled warheads and in propellant filled rocket motor cases given the impact of compact fragments or of small projectiles. Equations of velocities at which 50 percent of the explosive filled cases will initiate either high or low order are developed for compact fragments, and for projectiles. These data are used to establish the standard deviation of the data from the 50 percent initiation line. Standard deviation is used to provide predictions of the probability of initiation given the impact velocity and other pertinent parameters using equations and logic which are established in a computer model. This computer model uses fragment material properties and encounter parameters to predict fragment impact initiation, and projectile and casing material properties and encounter parameters to predict projectile impact initiation. S.F.

N81-17165* Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE INFLUENCE OF STRUCTURAL RESPONSE ON SYMPATHETIC DETONATION c25
Jerry L. Watson *In* NASA, Washington The 1980 JANNAF

Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 335-354 ref (For primary document see N81-17145 08-23) Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

The role that a munition's structural response plays in the ignition process and the development of violent reactions and detonations is explored. The munition's structural response is identified as one of the factors that influences reaction violence. If the structural response of a round is known, this knowledge can be used to redstruce the probability that a large explosion would result from the sequential detonation of individual rounds within a large storage array. The response of an acceptor round was studied. The castings fail in the same manner regardless of whether or not there is a fill material present in the round. These failures are caused by stress waves which are transformed from compressive waves to tensile waves by reflection as the impact energy moves around the casting. Since these waves move in opposite directions around the projectile circumference and collide opposite the point of impact, very high tensile forces are developed which can crack the casing. S.F.

N81-17166* Hercules, Inc., Magna, Utah.
SYMPATHETIC REACTION TESTS AND ANALYSES c28
David E. Ricardson and Allen L. Bowman *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 355-376 refs Prepared in cooperation with LASL (For primary document see N81-17145 08-23)
(Contracts N00030-74-C-0100; N00030-77-M-077002)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

The critical separation distances for explosive reactions of a solid rocket propellant were measured. Explosive reactions included low order explosion, low order detonation, and high order detonation. The effects of sample size, shape, damage and temperature on sympathetic reaction were determined experimentally. The sympathetic detonation of small cubes of solid rocket propellant was modeledl numerically, using the Eulerian reactive hydrodynamic code 2DE with Forest Fire burn rates. The model was applid to cubes of 2.54 - 7.62 cm (1 - 3 in.), with agreement between calculated and experimental results. Author

N81-17167# State Univ. of New York at Buffalo. Dept. of Chemistry.
LOW OXIDATION STATE, SIGMA BONDED ORGANOMETALLIC DERIVATIVES OF INDIUM (1)
O. T. Beachley, Jr. and R. N. Rusinko 25 Nov. 1980 22 p refs Submitted for publication
(Contract N00014-78-C-0562; NR Proj. 053-686)
(AD-A092897; TR-5) Avail: NTIS HC A02/MF A01 CSCL 07/3

The organoindium compounds, NaIn(CH2SiMe3)2 and NaIn(CH2SiMe3)2 MeOC2H4OMe, whose formulas indicate indium in the -1 oxidation state, have been prepared and characterized by elemental analyses, cryoscopic molecular weight measurements in benzene solution and infrared and 1H NMR spectral data. The novel indium(I) compounds were prepared from In(CH2SiMe3)3 and NaH in the appropriate solvent by an apparent reductive elimination reaction. The nature of the specific indium(I) product was dependent on the reaction solvent. When either aromatic or hydrocarbon solvents were used, a hexameric species (NaIn(CH2SiMe3)2)6, was formed. The product from dimethoxyethane, (NaIn(CH2SiMe3)2 MeOC2H4OMe)x exhibited an association which was concentration dependent. Structures which involve indium-indium bonds are proposed to account for the observed molecular association as well as the chemical and spectral properties. GRA

N81-17168# Naval Surface Weapons Center, White Oak, Md. Radiation Div.
MAGNETOSTRICTION OF LAVES PHASE RARE EARTH Ni2 COMPOUNDS
R. Abbundi and A. E. Clark 1 Jul. 1980 20 p refs Submitted for publication
(RR0220601)
(AD-A093074; NSWC/TR-80-303) Avail: NTIS HC A02/MF A01 CSCL 20/3

The magnetostriction of the RNi2 compounds (R - Tb,Dy,Ho,Er and Tm) was measured as a function of applied field from T - 5 K to above the Curie temperatures. A direct comparison is made between these results and the huge magnetostriction observed at cryogenic temperatures in the RFe2 and RCo2 compounds. The largest magnetostriction in the RNi2 series occurs in TbNi2. At T - 5 K the magnetostriction is fairly well saturated and results in a value of Lambda sub H Lambda sub T - .00227 at H - 25 kOe, while extrapolation to infinite field yields .00234. DyNi2 also displays a tendency to saturate at the higher fields at lower temperatures with Lambda sub H - Lambda sub T - -.000765 at 25 kOe and -840 ppm at H-infinity. The compounds HoNi2, ErNi2 and TmNi2 all exhibit large strains at T - 5 K although fail to saturate with available fields. At 25 kOe the magnetostriction for these compounds found to be -.000386, -.000415 and -.000552 respectively. GRA

N81-17169# Department of Energy, Washington, D. C. Div. of Materials Sciences.
MATERIALS SCIENCES PROGRAMS. FISCAL YEAR 1980, OFFICE OF BASIC ENERGY SCIENCES
Sep. 1980 173 p
(DOE/ER-0064) Avail: NTIS HC A08/MF A01

This report provides a convenient compilation index of the DOE Materials Sciences Division programs. This compilation is intended for use by administrators, managers, and scientists to help coordinate research and as an aid in selecting new programs and is divided into Sections A and B, listing all the projects, Section C, a summary of funding levels, and Section D, an index (the investigator index is in two parts, laboratory and contract research). DOE

24 COMPOSITE MATERIALS

Includes laminates.

N81-17170* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR ALLEVIATING THERMAL STRESS DAMAGE IN LAMINATES Patent
Charles A. Hoffman, John W. Weeton, and Norman W. Orth, inventors (to NASA) Issued 8 Jul. 1980 6 p Filed 6 Apr. 1978 Supersedes N78-22163 (16 - 13, p 1675)
(NASA-Case-LEW-12493-1; US-Patent-4,211,354; US-Patent-Appl-SN-893857; US-Patent-Class-228-118; US-Patent-Class-228-170; US-Patent-Class-228-174; US-Patent-Class-228-190; US-Patent-Class-156-292) Avail: US Patent and Trademark Office CSCL 11D

A method is provided for alleviating the stress damage in metallic matrix composites, such as laminated sheet or foil composites. Discontinuities are positively introduced into the interface between the layers so as to reduce the thermal stress produced by unequal expansion of the materials making up the composite. Although a number of discrete elements could be used to form one of the layers and thus carry out this purpose, the discontinuities are preferably produced by simply drilling holes in the metallic matrix layer or by forming grooves in a grid pattern in this layer.
Official Gazette of the U.S. Patent and Trademark Office

N81-17171*# Boeing Commercial Airplane Co., Seattle, Wash.
ASSESSMENT OF RISK TO BOEING COMMERICAL TRANSPORT AIRCRAFT FROM CARBON FIBERS Final Report, Sep. 1978 - Jan. 1980
C. A. Clarke and E. L. Brown Jun. 1980 94 p refs
(Contract NAS1-15510)
(NASA-CR-159211; D6-48855) Avail: NTIS HC A05/MF A01 CSCL 11D

The possible effects of free carbon fibers on aircraft avionic equipment operation, removal costs, and safety were investigated. Possible carbon fiber flow paths, flow rates, and transfer functions into the Boeing 707, 727, 737, 747 aircraft and potentially vulnerable equipment were identified. Probabilities of equipment removal and probabilities of aircraft exposure to carbon fiber were derived. J.M.S.

N81-17172# Royal Aircraft Establishment, Farnborough (England).
MECHANICS OF COMPOSITE MATERIALS. SUMMARY OF SOME THEORETICAL AND EXPERIMENTAL STUDIES
T. Vinh Jun. 1980 53 p refs Transl. into ENGLISH from Sci. et Techniques de l'Armement (France), v. 52, 1978
(RAE-LIB-Trans-2044; BR77096) Avail: NTIS HC A04/MF A01

Assessment by calculation and the dynamics of composite materials are discussed. Various methods for evaluating elastic constants (boundary methods using variational calculation, methods using Airy stress function, elastodynamic methods) and recent methods of calculation for multilayers in the plastic state are reviewed. Theories available for the propagation of waves and vibrations in composite materials (equivalent homogeneous media theory, microstructure theory, mixture theory, theory based on asymptotic development, etc.) are studied. Experimental researches for the calculation of elastic constants in micropolar elasticity under a static and dynamic regime are reviewed. The mechanical characteristics of composite materials are examined along with the corresponding experimental techniques (vibration of rods, ultrasonics, etc.). S.F.

N81-17173*# Composite Optics, Inc., San Diego, Calif.
MICROWAVE LIMB SOUNDER, GRAPHITE EPOXY SUPPORT STRUCTURE Final Report
George Pynchon 21 Nov. 1980 53 p refs Prepared for JPL
(Contracts NAS7-100; JPL-955701)
(NASA-CR-163929; JPL-9950484; COI-1180-0104) Avail: NTIS HC A04/MF A01 CSCL 11D

The manufacturing and processing procedures which were used to fabricate a precision graphite/epoxy support structure for a spherical microwave reflecting surface are described. The structure was made fromm GY-70/930 ultra high modulus graphite prepreg, laminated to achieve an isotropic in plane thermal expansion of less than + or - 0.1 PPM/F. The structure was hand assembled to match the interface of the reflective surface, which was an array of 18 flexure supported, aluminum, spherically contoured tiles. Structural adhesives were used in the final assembly to bond the elements into their final configuration. A eutectic metal coating was applied to the composite surface to reduce dimensional instabilities arising from changes in the composite epoxy moisture content due to environmental effects. Basic materials properties data are reported and the results of a finite element structural analysis are referenced. Author

N81-17174*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOWER-CURING-TEMPERATURE PMR POLYIMIDES
T. T. Serafini, P. Delvigs, and R. D. Vannucci 1981 17 p refs Presented at Thirty-Sixth Ann. Conf. of the Reinforced Plastics/Composites Inst. of the Soc. of the Plastics Ind., Inc., Washington, D.C., 16-20 Feb. 1981
(NASA-TM-81705; E-734) Avail: NTIS HC A02/MF A01 CSCL 11D

Studies were performed to achieve a lower-curing-temperature PMR polyimide. The use of m-aminostyrene as the end-cap instead of the monoalkyl ester of 5-normbornene-2,3 dicarboxylic acid was investigated in typical PMR formulations. Model compound studies were also performed. Differential scanning calorimetry studies were performed on model compounds and neat resins to establish their melting and curing characteristics. The elevated temperature weight loss characteristics of neat resins and graphite fiber composites were determined. The room temperature and short-time 260 C (500 F) mechanical properties of the composites were also determined. The use of m-aminostyrene end-caps reduced the final cure temperature of PMR resins by about 55 C (100 F), but the composites prepared with these resins are limited to use temperatures of about 260 C (500 F). Author

N81-17175*# HITCO, Gardena, Calif. Defense Products Div.
FABRICATION AND PHYSICAL TESTING OF GRAPHITE COMPOSITE PANELS UTILIZING WOVEN GRAPHITE FABRIC WITH CURRENT AND ADVANCED STATE-OF-THE-ART RESIN SYSTEMS Final Report
Samuel C. S. Lee Jun. 1979 26 p refs
(Contract NAS2-9977)
(NASA-CR-152292) Avail: NTIS HC A03/MF A01 CSCL 11D

Three weaves were evaluated; a balanced plain weave, a balanced 8-harness satin weave, and a semiunidirectional crowfoot satin weave. The current state-of-the-art resin system selected was Fiberite's 934 Epoxy; the advanced resin systems evaluated were Phenolic, Phenolic/Novolac, Benzyl and Bismaleimide. The panels were fabricated for testing on NASA/Ames Research Center's Composites Modification Program. Room temperature mechanical tests only were performed by Hitco; the results are presented. T.M.

N81-17176*# Grumman Aerospace Corp., Bethpage, N.Y.
EXPERIMENTAL DETERMINATION OF THE EFFECTS OF MOISTURE ON COMPOSITE-TO-COMPOSITE ADHESIVE JOINTS Final Report
Richard J. Delasi and Robert L. Schulte Washington NASA Feb. 1981 70 p refs
(Contract NAS1-15634)
(NASA-CR-3387; RE-610) Avail: NTIS HC A04/MF A01 CSCL 11D

The primary mode of moisture ingress into bonded composite joints is determined using a nuclear probe for deuterium (NPD) to measure the localized D2O content along the length of the adhesive (FM-300 and EA-9601) and through the thickness of bonded composite speciments. Calculated diffusivities and NPD measured equilibrium moisture contents are used to predict the moisture profiles along the length of the adhesives as a function of exposure time, temperature, and relative humidity. These results are compared with the observed moisture profiles to evaluate the extent of enhanced edge diffusion. The FM-300 adhesive exhibits good agreement between measured and predicted profiles at 49 C, 70% and 90% RH, and 77 C, 70% RH. At 77 C, 90% RH, the measured moisture content near the adhesive edge is substantially larger than the predicted level. The EA-9601 adhesive also shows good agreement at 49 C, 70% and 90% RH, but at 77 C, the concentration of D2O near the edges is enhanced at each humidity level. The effect of moisture content on the bond shear strength at room temperature and at elevated temperature is evaluated. M.G.

N81-17177*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
ON THE RELATIONSHIP BETWEEN ENGINEERING PROPERTIES AND DELAMINATION OF COMPOSITE LAMINATES Interim Report
Carl T. Herakovich Feb. 1981 25 p refs
(Contracts NAS1-15080; NCC1-15)
(NASA-CR-163956; VPI-E-81-2) Avail: NTIS HC A02/MF A01 CSCL 11D

The influence of the coefficient of mutal influence, Poisson's ratio and coefficients of thermal and moisture expansion on delamination is studied. Engineering theories are compared to finite element and experimental results. It is shown that the mismatch in coefficients of mutual influence can have a strong influence on delamination with fiber angles in the 10-15 degree range being critical for adjacent layer combinations. The mismatch in coefficient of mutual influence is reduced by a factor of two and the interlaminar shear stress is reduced significantly when the + or - adjacent layers are interspersed between 0 and 90 degree layers. It is shown how the results can be used for design of composite laminates. Author

N81-17178# Connecticut Univ., Storrs. Inst. of Materials Science.
WEAR OF HOMOGENEOUS AND COMPOSITE MATERIALS UNDER CONDITIONS OF REPEATED NORMAL AND SLIDING IMPACT Final Report
Stephen Rice, Roman Solecki, and Hans Nowotny 1980 39 p refs
(Contract F49620-79-C-0221; AF Proj. 2307)
(AD-A093166; AFOSR-80-1195TR) Avail: NTIS HC A03/MF A01 CSCL 11/4

This report describes experimental and analytical investigations in the area of wear of materials under repetitive impulsive and sliding contact. Both pin-on-disc and impact wear test machines have been utilized in conducting experiments involving solid contact between specimen and counterface materials. The

report includes a description of experimental methodology employed in research in wear, and enumerates the considerations relevant to a given experiment. Further noted are the deterministic external variables which serve to define operative wear regimes and processes. These variables include velocity, stress, test duration, environment and the effective mechanical stiffness of the specimen/counterface contact. Specific experimental results which illustrate phenomenologically distinct wear behaviors which arise due to differing levels in external variables are highlighted. The importance of these findings to further research in impact and sliding wear is noted. Analytical work has focused on the determination of states of stress and strain in material specimens undergoing repetitive impact. In particular, a bar striking an elastic half-space and a cylinder contacting a moving, rough, rigid plane were studied in some detail. These analytical results are applicable to the study of in situ material 'processing' during wear, and to the formation of subsurface zones arising both in impact and sliding wear. GRA

N81-17179# Army Materials and Mechanics Research Center, Watertown, Mass. Ceramics Research Div.

TRANSPARENT, POLYCRYSTALLINE CUBIC ALUMINUM OXIDE ***Final Report***

James W. McCauley and Normand D. Corbin Sep. 1980 19 p refs Presented at Army Sci. Conf., West Point, N.Y., 18-19 Jun. 1980 *Revised*

(DA Proj. 1L1-61102-AH-42)

(AD-A093683; AMMRC-MS-80-7) Avail: NTIS *HC A02/MF A01 CSCL 17/9*

The stringent mechanical/thermal and broadband electromagnetic wave transmission requirements for sensing mechanisms of the future require optimized and new material concepts. Aluminum oxide-based ceramics and single crystals are strong contenders for these applications, but exhibit significant directional variation (anisotropy) in properties. This barrier to utilization has been eliminated by an AMMRC-invented material - sintered polycrystalline nitrogen-stabilized cubic aluminum oxide (ALON). This material has been fabricated into dense, transparent bodies with isotropic properties: Knoop (100) hardness of 1800, elastic modulus of 46,000,000 psi, a dielectric constant and loss tangent, respectively, at 10 MHz of 8.56 and 0.0004, trivial oxidation in air up to 1200 C, an IR cutoff at 5.2 micrometer, and an average thermal expansion coefficient (alpha) of 0.000,007 per C (25 C-1000 C). These properties suggest greatly improved performance in many other Al2O3 applications. Successful fabrication of ALON was preceded by the determination of the high temperature phase equilibria and crystal chemistry of aluminum oxynitride spinels in the Al2O3-AlN system. GRA

N81-17180# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Mechanics and Surface Interactions Branch.

ELASTIC PROPERTIES OF T300/5208 BIDIRECTIONAL SYMMETRIC LAMINATES ***Final Report, 1 Sep. 1979 - 1 Jul. 1980***

Som R. Soni Sep. 1980 462 p refs

(AD-A093227; AFWAL-TR-80-4111) Avail: NTIS HC A20/MF A01 CSCL 11/4

Modulus components, compliance components, engineering constants, and their ratios and strengths for bidirectional symmetric laminates have been computed for T300/5208 graphite epoxy composites. These material properties are presented in graphic form as functions of either the laminate ply angle phi or the laminate angular rotation gamma. It has been found that the composites exhibit unique properties that do not have a counterpart in conventional materials. The results presented here are useful to designers for making a choice of composites for optimal performance. GRA

N81-17181# Bendix Corp., Kansas City, Mo.

SYNTACTIC FOAM COMPOSITES AND BONDING ***Final Report***

R. J. McWhirter Sep. 1980 34 p refs

(Contract DE-AC04-76DP-00613)

(BDX-613-2358) Avail: NTIS HC A03/MF A01

A manufacturing process was developed to produce billets molded from a composite of carbon microspheres, a polyimide resin, and carbon fibers. The billets then were machined to configuration which results in extremely sharp and fragile edges on one part. To strengthen these parts, a parylene coating was applied, after which the parts were assembled with other parts by bonding. Bonding and assembly problems are discussed in detail; other problems encountered are summarized, and several are referenced to previous reports. DOE

N81-17182# Hoya Glass Works, Tokyo (Japan).

INVESTIGATION ON THE DAMAGE THRESHOLD OF FILMS COATED ON VARIOUS SILICATE, FLUOROPHOSPHATE AND PHOSPHATE LASER GLASSES

Yuji Nakajima and Tetsuro Izumitani 1980 27 p *refs* Prepared in cooperation with Hoya Optics USA, Inc., Menlo Park, Calif.

(Contract DE-AC08-79DP-40096)

(DOE/DP-40096/1) Avail: NTIS HC A03/MF A01

Effects of substrate laser glass on the damage threshold and adhesion of dielectric films were studied in order to improve the damage threshold. The study is divided into two parts: the first part dealing with four types of laser glass, LSG-91H silicate, LHG-8 phosphate, P-1 phosphate and LHG-10 fluorophosphate; the second part dealing with twenty-six glasses with systematically modified compositions in three glass systems, silicate, phosphate, and fluorophosphate. DOE

N81-17183# Oak Ridge National Lab., Tenn.

LASER ANNEALING OF ION IMPLANTED SILICON

C. W. White, B. R. Appleton, and S. R. Wilson (Motorola, Inc., Phoenix, Ariz.) 1980 11 p refs Presented at the 6th Conf. on Appl. of Accelerators in Res. and Ind., Denton, Tex., Nov. 1980

(Contract W-7405-eng-26)

(CONF-801111-17) Avail: NTIS HC A02/MF A01

Pulsed laser annealing of ion implanted silicon leads to the formation of supersaturated alloys by nonequilibrium crystal growth processes at the interface occurring during liquid phase epitaxial regrowth. The interfacial distribution coefficients from the melt (k') and the maximum substitutional solubilities (C sub s sup max) are far greater than equilibrium values. Both K' and C sub s sup max) are functions of growth velocity. Mechanisms limiting substitutional solubilities are discussed. DOE

N81-17184# Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e. V., Darmstadt (West Germany). Lab. fuer Betriebsfestigkeit.

INFLUENCE OF LAMINATE MATERIAL AND LAMINATE STRUCTURE ON THE FATIGUE BEHAVIOR OF CARBON FIBER REINFORCED PLASTICS [EINFLUSS VON LAMINAT-WERKSTOFF UND LAMINATAUFBAU AUF DAS SCHWING-FESTIGKEITSVERHALTEN VON KOHLENSTOF-FASERVERSTAERKTEN KUNSTSTOFFEN]

E. Alschweig Bonn Bundesministerium fuer Verteidigung 1979 54 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteidigung

(BMVg-FBWT-79-24) Avail: NTIS HC A04/MF A01

High tensile graphite/epoxy composite unnotched laminate specimens were studied. The influence of fiber material and laminate structure was investigated using specimens out from the same laminate, but in one case with the longitudinal specimen axis perpendicular to the zero degree direction. A high modulus fiber laminate had the same buildup. Results show that, the high modulus fiber composite is stiffer than the light tensile laminate, but the strain of fracture with tensile and compressive loading is less than half of that of the high tensile composite. The fatigue strength is remarkably lower for the high modulus composite in the low and medium cycle range of the S-N curve. In the region of the endurance limite the strength values are similar. The stiffness loss during fatigue loading was less than 10% shortly before failure. The high tensile specimens with longitudinal axis perpendicular to the zero degree direction were then investigated under static and dynamic loading.

Author (ESA)

N81-17185# Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e. V., Darmstadt (West Germany). Lab. fuer Betriebsfestigkeit.

EXAMINATION OF FATIGUE BEHAVIOR IN UNNOTCHED AND NOTCHED FIBER COMPOSITE MATERIAL SPECIMENS TAKEN FROM MULTIDIRECTIONAL LAMINATES

[SCHWINGFESTIGKEITSUNTERSUCHUNGEN AN UNGEKERBTEN UND GEKERBTEN FASERVERBUNDWERKSTOFFPROBEN AUS MULTIDIREKTIONALEM LAMINAT]

J. J. Gerharz, D. Rott, and D. Schuetz Bonn Bundesministerium fuer Verteidigung 1979 104 p *refs In GERMAN; ENGLISH summary* Sponsored by Bundesministerium fuer Verteidigung (BMVg-FBWT-79-25) Avail: NTIS HC A06/MF A01

To provide design data, the stress-strain behavior during monotonic loading, the fatigue behavior during constant and variable amplitude loading, and the deformation behavior during *fatigue loading of unnotched and notched graphite/epoxy* composite specimens was investigated. Results show that the stress-strain behavior of the laminate is *nearly linear; with increasing compressive loading strain increases progressively and* with increasing tensile loading the strain increases degressively. The S-N curves show that the drop in fatigue strength from the static strength is largest for load cycles with large portions in compression. Continuous measurements of the deformation during *fatigue loading reveal a nonlinear increase in deformation which* is largest within the first and last 20% of the total life to fracture. Generally, the increase in deformation is deformation is larger *during constant amplitude than during variable amplitude loading.* The stress concentration of the notched speciment decreases static strength and fatigue strength in the low cycle region *drastically.* *Author (ESA)*

N81-17186# Liege Univ. (Belgium). Lab. d'Aeronautique.

MODELING COMPOSITE MATERIALS BY FINITE ELEMENT METHODS [MODELISATION DES MATERIAUX COMPOSITES DANS LES METHODES D'ELEMENTS FINIS)

G. Sander and C. Nyssen Paris Assoc. Aeron. et Astronautique de France 1979 37 p refs In FRENCH Presented at 14th Intern. AAAF Aeron. Congr., Paris, 6-8 Jun. 1979 (AAAF-NT-79-31; ISBN-2-7170-0597-X) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 34 (France and EEC) FF 39 (others)

Matrix methods used in determining the mechanical properties of laminated composite materials in a linear domain are reviewed, *then results are introduced into well-known finite element models.* Nonlinear examples of these models, applicable to laminated, are examined. The case of a pressure vessel tested to failure is *postulated. Analysis results show the importance of predicting* constraints bearing on transversal shear strength as well as on shear between layers, the values of which are often numerically *small, although important at the initiation of failure modes.*

Author (ESA)

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes *chemical analysis, e.g., chromatography;* combustion theory; electrochemistry; and photochemistry.

For related information see also 77 Thermodynamics and Statistical Physics.

N81-17187* National Aeronautics and Space Administration. *Pasadena Office, Calif.*

INSOLUBLE POLYELECTROLYTE AND ION-EXCHANGE HOLLOW FIBER IMPREGNATED THEREWITH Patent

Alan Rembaum, inventor (to NASA) (JPL) Issued 29 Mar. 1977 9 p *Filed 4 Apr. 1974* Sponsored by NASA (NASA-Case-NPO-13530-1; US-Patent-4,014,798; *US-Patent-Class-210-500M; US-Patent-Class-260-2.1;* US-Patent-Class-260-2.2R) Avail: US Patent and Trademark Office CSCL 07D

The number of quaternary sites and ion exchange capacity of a polyquaternary, cross linked, insoluble copolymer of a vinyl pyridine and a dihalo organic compound is increased by about *15-35% by reaction of the polymer with an amine followed by* quaternization, if required. The polymer forms spontaneously in the presence of a substrate such as within the pores of a hollow *fiber. The improved resin impregnated fiber may be utilized to* remove ions from waste or process steams.

Official Gazette of the U.S. Patent and Trademark Office

N81-17188*# National Aeronautics and Space Administration. *Lyndon B. Johnson Space Center, Houston, Tex.*

JSC SYSTEMS USING SOLID CERAMIC OXYGEN ELECTROLYTE CELLS TO MEASURE OXYGEN FUGACITES IN GAS-MIXING SYSTEMS

Richard J. Williams and Oscar Mullins (Lockheed Electronics Corp., Houston, Tex.) Jan. 1981 44 p refs (NASA-TM-58234; JSC-17022) Avail: NTIS HC A03/MF A01 CSCL 07D

Details are given for the construction and operation of a 101.3 KN/sq meter (1 atmosphere) redox control system. A solid ceramic oxygen electrolyte cell is used to monitor the oxygen fugacity in the furnace. *The system consists of a vertical quench* gas mixing furnace with heads designed for mounting the electrolyte cell and with facilities for inserting and removing the samples, a *simplified version of a gas mixing apparatus, and* devices for experiments under controlled rates of change of temperature. A thermogravimetric analysis system employing these *techniques of redox control and measurement is also described.* The calibration and maintenance of the system are discussed.

Author

N81-17189*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ACCEPTANCE TESTS AND MANUFACTURER RELATIONSHIPS FOR 20 AMPHERE-HOUR SEALED NICKEL-CADMIUM CELLS USING DISCHARGE PARAMETERS

Harold F. Leibecki Nov. 1980 31 p refs (NASA-TM-81619; E-625) Avail: NTIS HC A03/MF A01 CSCL 10C

One hundred and forty-six 20 ampere-hour sealed nickel cadmium cells from five manufacturers were detected using *preliminary tests which do not require life testing and do not* reduce the expected life of the cells. Differences between individual cells were also detected, using these tests, allowing a comparison *of variability of cell construction by and between manufacturers.*

Author

N81-17190# Missouri Univ. -Rolla. Dept. of Physics.

KINETIC PROCESSES IN HIGH PRESSURE GASES' EXCITED STATE COLLISIONS ***Technical Report, Dec. 1979 - Dec. 1980***

Laird D. Schearer and Robert H. McFarland 1 Dec. 1980 30 p *refs* (Contract N00014-75-C-0477; NR Proj. 343-011) (AD-A092683; TR-13) Avail: NTIS HC A03/MF A01 CSCL *07/4*

A nitrogen-pumped dye laser system has been used to investigate the 3(2P) yields n(2)D(3/2), (5/2) and 3(2P)(1/2), *3-2 yields n(2)S(1/2) (6 + or - n + or - 22) line profiles for* sodium perturbed by .2 to 2 Amagats of argon. Sodium was ionized in a stepwise process which incorporated one of the *above resonant transitions as an intermediate step. The relative* ion yield was determined as a function of laser wavelength and the resulting data analyzed to obtain absorption profiles and *line shifts for nd, ns yields 3p transitions. We report the total* Penning ionization cross sections for He(2(3)S(1)) atoms incident on Cd and Zn. The measurements are made for relative collision *velocities above thermal by using a beam. Previous metal vapor* studies of Cd and Zn have been confined to thermal velocities in pulsed after-glow experiments. We also report the observation *of HgBr(B-X) fluorescence resulting from collisions of HgBr2 with* a vibrationally excited beam of nitrogen molecules in the A(3) *sigma (-) (mu) electronic state.* GRA

N81-17191# Alberta Univ., Edmonton. Dept. of Chemistry.

SIMULATION OF ELECTROCHEMICAL PROCESSES BY ORTHOGONAL COLLOCATION, SPHERICAL ELECTRODE GEOMETRY

B. Stanley Pons 8 Dec. 1980 32 p refs (Contract N00014-80-G-0107) (AD-A092964; TR-3) Avail: NTIS HC A03/MF A01 CSCL *07/4*

Discretization formulas for the digital simulation of the diffusional processes associated with a variety of electrochemical *processes at a spherical electrode are given. The formulas are* based on orthogonal collocation techniques. Several mechanisms are represented, and the technique is demonstrated for

chromoamperometry, chronopotentiometry, and cyclic voltammetry. GRA

N81-17192# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

STUDY OF TEXTURED N-TYPE SILICON PHOTOANODES: ELECTRON MICROSCOPY, AUGER, AND ELECTROANALYTICAL CHARACTERIZATION OF CHEMICALLY DERIVATIZED SURFACES Interim Technical Report

James A. Bruce and Mark S. Wrighton 5 Dec. 1980 42 p refs Submitted for publication

(Contract N00014-75-C-0880; NR Proj. 051-579)

(AD-A092996; TR-23) Avail: NTIS HC A03/MF A01 CSCL 07/4

Polished (111), (100), and textured (100) single crystal, n-Si surfaces have been studied in relation to their use as a photoanode materials in a photoelectrochemical device. Textured (100) Si is prepared by chemically etching the polished (100) surface. The textured surface consists of pyramids having (111) sides, necessitating the study of polished (111) Si as a comparison. Electron microscopy and Auger spectroscopy have been employed to characterize textured and polished surfaces functionalized with the electroactive reagents (1,1-ferrocenediyl)dimethylsilane and (1,1-ferrocenediyl)dichlorosilane. Electrochemical techniques have been used to determine coverage of electroactive material, and the textured surface is found to bind about twice as much material as the polished surfaces. The charge transfer properties of the surface-confined material on the polished (100) and (111) Si are virtually identical: the position of the photoanodic wave corresponding to uphill ferrocene oxidation is within 30 mV and the ferricenium reduction peak is also at the same potential. The textured (100) Si surface shows a slightly more positive (100 mV) photoanodic and dark cathodic peak. Photoelectrochemical cells based on textured (100) Si vs. polished (100) Si are about 20% better in overall efficiency due to lower reflection losses associated with the textured surface. GRA

N81-17193# Texas A&M Univ., College Station. Dept. of Chemistry.

A RATIO METHOD FOR FLUORESCENCE SPECTRAL DECONVOLUTION Interim Technical Report

Michael P. Fogarty and Isiah M. Warner 20 Nov. 1980 44 p refs Submitted for publication

(Contract N00014-80-C-0703; NR Proj. 051-747)

(AD-A093374; TR-1) Avail: NTIS HC A03/MF A01 CSCL 07/4

A procedure is described for the spectral deconvolution of multicomponent fluorescence data using a ratio method. The only criteria for deconvolution is that each component must have a spectral region where it is the only emitter and that the acquired data sets have a reasonable signal to noise ratio. The ratio method described is an extension of an algorithm previously developed for deconvolution of one dimensional infrared data. Examples of applications of this algorithm for one dimensional and two dimensional fluorescence data are provided. In addition, an example is given as to how fluorescence quenching can be used to aid in spectral deconvolution. GRA

N81-17194# Ohio State Univ., Columbus.

STUDIES ON THE CONVERSION OF PENTABORANE (9) TO DECABORANE (14), PART 3

Sheldon G. Shore Dec. 1980 6 p

(Grant DAAG29-78-G-0112)

(AD-A092995; ARO-15611.6C-Pt-3) Avail: NTIS HC A02/MF A01 CSCL 07/3

This report supercedes and makes obsolete two earlier technical reports (Parts 1 and 2) submitted to ARO entitled: 'Studies on the Conversion of Pentaborane (9) to Decaborane (14)'. We now have a simple method for producing in the laboratory good quality B10H14 from B5H9 in yields of 42-45%. Additionally we have been able to replace the costly reagents KH, BBr3 and N(n-C4H9)4 Br with the much cheaper reagents NaH, BC13, N(CH3)4 C1. We believe that this procedure is ready for scale-up tests in 1/2 to 1 pound quantities in a pilot plant reactor. Given below is a detailed description of our laboratory procedure for preparing B10H14 in 1 gram quantities. GRA

N81-17195# Aerospace Corp., El Segundo, Calif. Lab. Operations.

ISOTOPIC DETERMINATION OF LEAD BY SECONDARY ION MASS SPECTROMETRY Interim Report

Patricia A. Bertrand, Reinhold Bauer, and Paul D. Fleischauer 15 Dec. 1980 20 p refs

(Contract F04701-80-C-0081)

(AD-A093759; TR-0081(6403-02)-1; SD-TR-80-59) Avail: NTIS HC A02/MF A01 CSCL 07/4

A method is described by which samples containing as little as 5 ng of lead can be isotopically analyzed. The procedure was developed for use with lubricating oils containing additives labeled with particular lead isotopes, but it can also be applied to the determination of lead in other materials. It consists of three steps: (1) digestion of the organic sample to release the lead into aqueous solution, (2) anodic deposition of the lead onto platinum electrodes, and (3) secondary ion mass spectrometry. Quantitative determination of the amount of lead in a sample can be accomplished by adding to the sample a known amount of a standard lead compound with an isotopic composition different from the sample. GRA

N81-17196# ARO, Inc., Arnold Air Force Station, Tenn.

TEMPERATURE-COMPENSATED HIGH-RESOLUTION INFRARED ABSORPTION SPECTROSCOPY: APPLICATION TO CARBON MONOXIDE Final Report, Oct. 1978 - Jun. 1979

C. J. Fisher and W. P. Dixon AEDC Jan. 1981 34 p refs Sponsored by AF

(AD-A094004; AEDC-TR-79-100) Avail: NTIS HC A03/MF A01 CSCL 07/4

The analytic basis of an optical absorption technique suitable for a single line-of-sight determination of average gaseous species number densities in the presence of concentration, pressure and temperature gradients, and particulate loading is presented and applied to carbon monoxide (CO). Applying the technique involves using the power of very high-resolution infrared (IR) spectroscopy, now made available by tunable diode lasers. The method requires the construction of functions of molecular line strengths that are nearly temperature independent. A method of constructing these functions is described and applied to the case of CO. Possible applications to practical combustion systems are also outlined. GRA

N81-17197# Texas Univ. at Austin. Dept. of Chemistry.

SEMICONDUCTOR ELECTRODES, 33. PHOTOELECTROCHEMISTRY OF N-TYPE WSe2 IN ACETONITRILE

Henry S. White, Fu-Ren F. Fan, and Allen J. Bard 6 Jan. 1981 34 p refs Submitted for publication

(Contract N00014-78-C-0592)

(AD-A093845) Avail: NTIS HC A03/MF A01 CSCL 09/1

The photoelectrochemical behavior of n-type WSe2 single crystal electrodes in acetonitrile solutions containing several redox couples was investigated. Electrodes with discontinuities in the vanderWaals' surface show large dark currents and recombination of electrons with photooxidized solution species. Pretreatment of such a surface with Cl(-) passivates these dark active sites and increases the photocurrent density. The observed photopotentials at WSe2 for redox couples with potentials, V sub redox, more positive than 0.5 V vs SCE show behavior consistent with Fermi level pinning; the onset potential of photocurrents increases linearly with increasing V sub redox while the photopotential remains constant. The energy position at which pinning occurs depends on the density of surface states and the concentration of solution species. GRA

N81-17198# Utah Univ., Salt Lake City. Dept. of Chemistry.

MECHANISMS AND PROCESSES FOR CONVERSION OF SMALLER BORANES TO LARGE BORANES OR BORANE FRAGMENTS Final Report, 15 Dec. 1975 - 30 Sep. 1980

Robert W. Parry and Goji Kodama 1 Oct. 1980 22 p refs

(Contract DAAG29-79-C-0129; Grant DAAG29-76-G-0120)

(AD-A093783; ARO-13451.6-CX; ARO-16243.5-CX) Avail: NTIS HC A02/MF A01

Successful isolation and characterization of Me3NB4H8 revealed an aspect of the base catalysis of borane condensation, and triggered the discovery of new hypho class compounds B4H8(2PMe3) and B3H5(3PMe3). Formation of a new class

(klado) of compound B4H6(4PMe3) was confirmed also. These higher class compounds are promising reagents for borane expansion. A triborane cation, (B3H6(PMe3)2)-, was prepared from B2H4(2PMe3). The diborane(4) adduct can be used as a reagent for borane expansion. An attempted conversion of B5H9 to B10H14 is described. GRA

N81-17199# New York Univ., N. Y. Dept. of Chemistry.
PHOTOELECTRON EMISSION SPECTROSCOPY OF INORGANIC CATIONS IN AQUEOUS SOLUTION
Paul Delahay, Kathrine VonBurg, and Andrew Dziedzic Dec. 1980 22 p refs
(Contract N00014-74-C-0397)
(AD-A093726; TR-13) Avail: NTIS HC A02/MF A01 CSCL 07/4

Threshold energies (6.1 less than E sub t equal to or lesser than 8.6h eV) are determined for photoelectron emission by 16 inorganic cations in aqueous solution. E sub t:s are correlated with gas-phase ionization potentials, solvation and reorganization free energies, standard reduction potentials and ligand field stabilization energies (five transition metals). Dielectric saturation is shown to drastically lower threshold energies. GRA

N81-17200# North Carolina Univ. at Chapel Hill. Dept. of Chemistry.
NEW MAGNETIC AND STRUCTURAL RESULTS FOR UNIFORMLY SPACED, ALTERNATINGLY SPACED, AND LADDER-LIKE COPPER (2) LINEAR CHAIN COMPOUNDS Interim Technical Report
William E. Hatfield 15 Dec. 1980 13 p refs Submitted for publication
(Contract N00014-76-C-0816)
(AD-A093586; TR-15) Avail: NTIS HC A02/MF A01 CSCL 07/3

Results of recent synthetic, structural, and magnetic work on exchange coupled copper (II) ions bridged by nonmagnetic ligands are discussed, including the quasi-linear chain compound bis(dimethyldithiocarbamato)copper(II) in which the copper(II) ions are antiferromagnetically exchange coupled. An unusual correlation exist in the structural and magnetic data for (Cu(dmtc)2) infinity and other known sulfur bridged copper compounds. Data are presented for the laternatingly spaced linear chain compounds di-mu-chlorobis-(4-methylpyridin e)copper (II), and a series of dionebis(thisosemicarbazato)copper(II) compounds. Exchange coupling constants and alternation parameters were obtained from expressions which were empirically generated from calculations on rings of ten S - 1/2 ions for kT/(absolute value of J) approx - or = 0.5 and J - 0. Finally, New results for recently discovered spin ladder systems are presented. GRA

N81-17201# Northwestern Univ., Evanston, Ill.
COMBUSTION STUDIES OF OIL/WATER EMULSIONS Final Report, 1 Aug. 1977 - 30 Sep. 1980
C. K. Law Nov. 1980 10 p refs
(Grant DAAG29-77-G-0188)
(AD-A093712; ARO-15102.7-E) Avail: NTIS HC A02/MF A01 CSCL 21/2

The fundamental combustion characteristics of water/oil emulsions are studied. It is identified that the combustion behavior primarily depends on: (1) the relative volatilities and concentrations of water and oil, (2) the liquid-phase motion, and (3) the fact that water and oil do not mix. Based on these various theoretical models, descriptions of droplet combustion in sprays are formulated and subsequently verified experimentally. The potential of disruptive droplet combustion leading to enhanced atomization and mixing are explored. A possible mechanism which may be responsible for the fire-safety nature of water/oil emulsions is suggested and directions for further optimization of emulsion formulation based on this concept are identified. Diesel engine testings show significant reduction in soot emulsion without adverse effect in combustion efficiency by using emulsions with 10 to 20 percent water. GRA

N81-17202# Oregon State Univ., Corvallis. Dept. of Physics.
MOTIONAL CORRELATION TIME OF DILUTE 111Cd IMPURITIES IN LIQUID S AND Se
D. K. Gaskill, J. A. Gardner, K. S. Krane, K. Krusch, and R. L. Rasera 10 Dec. 1980 10 p refs Presented at the 5th Intern. Conf. on Hyperfine Interactions, Berlin, 1980 Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville, Md.
(Contract N00014-79-C-0668)
(AD-A093693; TR-1) Avail: NTIS HC A02/MF A01 CSCL 07/4

The elements sulfur, selenium and tellurium have been extensively studied in the liquid state on account of their interesting electrical and physical properties. According to current understanding, these materials exist in the liquid in the form of chain- or ring-shaped molecules, depending on the material and temperature range. Their electrical properties are strongly influenced by bonding irregularities in the predominant structure, such as chain ends, branches or impurities. As temperature increases, the relative concentration of these effects in bonding also increases, with a concomitant increase in the conductivity. Physically, the viscosity of the liquids decreases rapidly with increasing temperature, suggesting that the liquids undergo marked structural changes (ring-chain transformation, and shortening of chain length with increasing temperature, for example). Although powerful tools such as NMR, neutron scattering, and viscosity measurements, among many others, have been used to study these materials, a complete understanding of the dynamical behavior of these liquids is still lacking. We describe here an application of time-differential perturbed angular correlation (TDPAC) to the study of molecular dynamics in liquid S and Se. GRA

N81-17203# Oregon State Univ., Corvallis. Dept. of Physics.
MOTIONAL CORRELATION TIME OF DILUTE 111 Cd IMPURITIES IN Se-RICH LIQUID Se-Te ALLOYS Interim Report
D. K. Gaskill, J. A. Gardner, K. S. Krane, K. Krusch, and R. L. Rasera 10 Dec. 1980 7 p refs Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville Submitted for publication
(Contract N00014-79-C-0668; NR Proj. 056-721)
(AD-A093694; TR-2) Avail: NTIS HC A02/MF A01 CSCL 07/4

The motional correlation time, tau sub c, in liquid Se and Se rich Se Te alloys was investigated between 500 and 900 C using time differential perturbed angular correlations of gamma rays from dilute Cd111 impurities. In all alloys we find tau sub c exp (E sub c/kT) at low T where E sub 0 = 0.36 eV. The tau sub c deviates from this relation at high T. At low T, tau sub c is tentatively identified as the lifetime of a Cd to host molecule bond, and at high T as the average lifetime of bonds in the host molecule. R.C.T.

N81-17204# State Univ. of New York at Buffalo. Dept. of Chemistry.
ELECTROCHEMISTRY AND ELECTROCHEMICAL METHODOLOGY IN MOLTEN SALTS Final Report, 1 Jun. 1979 - 30 Sep. 1980
Robert A. Osteryoung and Janet G. Osteryoung Sep. 1980 29 p refs
(Contract F49620-79-C-0142; AF Proj. 2303)
(AD-A093871; AFOSR-80-1371TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

This work involved chemical and electrochemical studies in a room temperature molten salt, N-butylpyridinium chloride (BuPyCl); aluminum chloride together with efforts to devise and develop better electrochemical methods for the studies of reactions in these solvents. The reduction of the butylpyridinium cation, which is reduced prior to Al in a basic (excess BuPyCl) melt was studied It was shown that coupling takes place to lead to the formation of viologen species. The deposition of Al from this melt and the melt mixed with benzene as a cosolvent was studied; it was found that the acid-base properties of the solvent are unchanged when diluted with benzene: GRA

N81-17205# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
PHOTOCHEMISTRY OF METAL-METAL BONDED TRANSITION ELEMENT COMPLEXES Interim Technical Report
Mark S. Wrighton, James L. Graff, John C. Luong, Carol L. Reichel, and John L. Robbins 12 Dec. 1980 35 p refs
(Contract N00014-75-C-0880; NR Proj. 051-579)

(AD-A093972; TR-25-ONR) Avail: NTIS HC A03/MF A01 CSCL 07/4

Transition metal complexes that have direct metal-metal bonds have been the objects of intense interest from the point of view of geometric and electronic structure, synthesis and catalysis. Low-lying electronic excited states of metal-metal bonded complexes often involve significant changes in the electron density associated with the metal-metal bond, compared to the ground electronic state. Accordingly, study of the photochemistry of metal-metal bonded complexes not only provides potential new reaction chemistry but also provides insight into, and confirmation of, the electronic structure. This symposium volume affords us an opportunity to record the state of the field of metal-metal bond photochemistry. The aim of this article is to summarize recent research results from this laboratory and to place them in perspective in relation to results from other laboratories. GRA

N81-17206# National Bureau of Standards, Washington, D.C. Chemical Stability and Corrosion Div.

CHARACTERIZATION BY TIN-SPECIFIC SIZE EXCLUSION CHROMATOGRAPHY OF THE FREE RADICAL COPOLYMERIZATION OF TRIBUTYLTIN METHACRYLATE AND METHYL METHACRYLATE Interim Technical Report

E. J. Parks, F. E. Brinckman, C. E. Mullin, D. M. Anderson, and V. J. Castelli 11 Dec. 1980 20 p refs Prepared in cooperation with Naval Ship Research and Development Center, Annapolis, Md. Submitted for pubtlication

(NR Proj. 356-689)

(AD-A093532; Rept-561-0406) Avail: NTIS HC A02/MF A01 CSCL 07/4

Copolymers of tributyltin methacrylate (TBTM) and methyl methacrylate (MMA) comprise an important class of biocidal slow-release organotin polymers (OMP's). Little is known of the kinetics and mechanism of copolymerization. TBTM and MMA were copolymerized in the presence of a free radical initiator (benzoyl peroxide) at 80.1 C. Aliquots, taken at preselected intervals from 0 to 1440 min, were fractionated by size exclusion chromatography (SEC) coupled with ultraviolet (UV) and tin-specific graphite furnace atomic absorption (GFAA detectors, A UV absorbance observed at 254 nm was associated with low molecular weight (MW) species, decreasing in concentration continuously with time of reaction. Tin-specific GFAA indicated a decrease in low MW species (c. 350 daltons) with concurrent increases in high MW species (c. 40,000 daltons). The fraction of high MW increased as a linear function of the logarithm of the time of reaction. SEC-UV-GFAA thus provides a tool of major importance for characterizing the time dependence and continuity of the process by which monomers of TBTM are converted to a useful bioactive slow-release coating material. GRA

N81-17207# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.

RAMAN CAPABILITIES FOR AEROSOL CHARACTERIZATION Final Report, 1 Oct. 1978 - 30 Sep. 1980

Richard K. Chang Nov. 1980 12 p refs

(Grant DAAG29-79-G-0008)

(AD-A093704; ARO-15030.6-GS) Avail: NTIS HC A02/MF A01 CSCL 07/4

Chemical speciation of microparticles can be achieved by spectral and intensity analyses of the inelastically scattered radiation (Raman and fluorescence). However, quantitative results by purely optical methods are intimately related to the environment with which the particles are in contact and the morphology of the microstructures. Morphology characterization of regularly shaped microparticles (spheres, cylinders, and spheroids) can be obtained by measuring the peaks in the extinction and elastically scattering spectra. Our investigation on the viability of quantitative species identification of molecules within a microparticle by inelastic laser scattering involved studies of the following: (1) dielectric and metal substrate interface to increase the intensity of the scattered radiation; and (2) morphology dependent dielectric resonances which can modify the scattering spectra. GRA

N81-17208# Northwestern Univ., Evanston, Ill. Dept. of Mechanical and Nuclear Engineering.

INVESTIGATION OF METAL AND METAL OXIDE CLUSTERS SMALL ENOUGH TO CONSTITUTE THE CRITICAL SIZE FOR GAS PHASE NUCLEATION IN COMBUSTION PROCESSES Final Report, 1 Oct. 1975 - 30 Jun. 1979

Gilbert D. Stein Nov. 1980 154 p refs

(Contract N00014-76-C-0378)

(AD-A093950; TR-17) Avail: NTIS HC A08/MF A01 CSCL 07/4

Over the course of this contract a variety of techniques have been employed to study the properties of small atomic and molecular clusters formed in the gas phase via homogeneous nucleation. The clustering occurs either in an adiabatic expansion of a condensable species (e.g., argon, krypton, xenon, or sulfur hexafluoride) in an inert carrier gas (e.g., helium), or as a mixing process using a hot condensable (e.g., lead, silver, copper, indium or bismuth) and a cold carrier gas (e.g., argon, helium, carbon dioxide or sulfur hexafluoride). A continuous development of several types of cluster sources has been carried out and includes free jets, very small hypersonic laval nozzles, and a series of metal ovens with carrier gas mixing. Any one, of these sources, constitutes the first stage of a differentially pumped, molecular beam system which then produces a continuous beam of clusters. The density in the beam is so low that it is collisionless and thus the clusters do not interact with each other or with any other foreign molecule or surface. The study of these isolated clusters is carried out primarily using high energy electron beams (40 to 75 KeV). The resulting diffraction patterns are obtained either on film or through use of a single channel, scintillation, pulse counting system employing synchronous detection. GRA

N81-17209# SRI International Corp., Menlo Park, Calif.

STUDIES OF THE GaAs/OXIDE INTERFACE USING A LIQUID ELECTRODE Final Report, 28 Sep. 1979 - 27 Sep. 1980

S. Roy Morrison, Karl W. Frese, Jr., and M. J. Madou Nov. 1980 6 p

(Contract DAAG29-77-C-0049; SRI Proj. 6983)

(AD-A093806; ARO-15329.4-EL) Avail: NTIS HC A02/MF A01 CSCL 07/4

Anodically grown oxides on GaAs were produced and their electrical properties measured by electrochemical techniques. It was concluded that residual unoxidized arsenic dissolved in the oxide causes poor insulating characteristics, and methods to correct the problem were examined. GRA

N81-17210# Wisconsin Univ. - Madison. Dept. of Chemistry.

LUMINESCENT PHOTOELECTROCHEMICAL CELLS. 5: MULTIPLE EMISSION FROM TELLURIUM-DOPED CADMIUM SULFIDE PHOTOELECTRODES AND IMPLICATIONS REGARDING EXCITED STATE COMMUNICATION

Bradley R. Karas, Holger H. Streckert, Rodney Schreiner, and Arthur B. Ellis 3 Dec. 1980 26 p refs Submitted for publication

(Contract N00014-78-C-0633; NR Proj. 051-690)

(AD-A093692; TR-6) Avail: NTIS HC A03/MF A01 CSCL 07/4

Samples of single crystal, n-type, 100 ppm Te-doped CdS (CdS:Te) exhibit two emission bands when excited at several ultraband wavelengths. When CdS:Te was used as the photoanode in a photoelectrochemical cell employing sulfide electrolyte, both emission bands were quenched in parallel during passage of photocurrent resulting from 457.9 or 476.5 nm Ar ion laser excitation. The existence of excited state communication is inferred from the effects of temperature and electrode potential on multiple emission. T.M.

N81-17211# Wisconsin Univ. - Madison. Dept. of Chemistry.

LUMINESCENT PHOTOELECTROCHEMICAL CELL. 4: ELECTROLUMINESCENT PROPERTIES OF UNDOPED AND TELLURIUM-DOPED CADMIUM SULFIDE ELECTRODES

Holger H. Streckert, Bradley R. Karas, David J. Morano, and Arthur B. Ellis 3 Dec. 1980 27 p refs Submitted for publication

(Contract N00014-78-C-0633; NR Proj. 051-690)

(AD-A093695; TR-5) Avail: NTIS HC A03/MF A01 CSCL 07/4

An understanding of electrochemistry at semiconductor electrodes requires knowledge of the role intraband gap states

play in mediating interfacial charge transfer. Reference to surface states is especially prevalent in the photoelectrochemical cell (PEC) literature. The existence of intraband gap states has been supported in part by electroluminescence (EL) studies: Electrolyte species capable of hole injection into the valence bands of n-type, semiconducting TiO2, SrTiO3, CdS, GaP, ZnO, and GaAs yielded luminescence at sub-band gap energies. Since the valence band edges of these materials are generally at very positive potentials, valence band hole injection requires a potent oxidizing species. Aqueous alkaline peroxydisulfate (OH(-)/S2O8(2-)) electrolyte has been the medium of choice for observing the effects. GRA

N81-17212# Westminster Coll., Fulton, Mo. Dept. of Physics.

AN INVESTIGATION OF THE TECHNIQUES OF ELLIPSOMETRY, INTERNAL REFLECTION SPECTROSCOPY, AND MOMENT ANALYSIS TO THE STUDY OF FILMS AND SUBSTRATES Final Report, 1 Oct. 1978 - 1 Sep. 1980

Kent F. Palmer and Michael Z. Williams AEDC Jan. 1981 72 p refs Sponsored by AF Prepared for ARO, Inc., Arnold Air Force Station, Tenn.

(AD-A093930; AEDC-TR-80-51) Avail: NTIS HC A04/MF A01 CSCL 07/4

Ellipsometry and internal reflection spectroscopy (IRS) are two methods of spectroscopic measurement which have some unique advantages over other reflection techniques for the study of films and substrates. Applications of these methods are fully discussed for work in the infrared and visible spectral regions. Moment analysis of spectral band shapes has been shown theoretically to yield information on the nature of the intermolecular interactions in condensed phases. These data are vital if concentrations of molecular species are to be found in a film. The experimental difficulties of moment analysis are discussed along with some preliminary results using existing AEDC data. Areas for future research are suggested for the spectroscopic analysis of films. GRA

N81-17213# California Univ., Santa Barbara. Dept. of Physics.

HYDROGENATION OF CO ON ALUMINA SUPPORTED METALS: A TUNNELING SPECTROSCOPY STUDY

R. M. Kroeker (IBM Research Lab., San Jose, Calif.), P. K. Hansma, and W. C. Kaska Dec. 1980 12 p refs Presented at ACS Symp. Ser.: Catalytic Activation of CO, Santa Barbara, Calif., Dec. 1980

(Contract N00014-78-C-0011; Grant NSF DMR-79-25430-23) (AD-A093285; TR-7) Avail: NTIS HC A02/MF A01 CSCL 07/4

The hydrogenation of CO on alumina supported metals has been the subject of many research efforts. This report is about the application of a relatively new technique, tunneling spectroscopy, to the problem of identifying the reaction intermediates that are formed on the catalyst surface. Tunneling spectroscopy is a vibrational spectroscopy that presents information about the system being studied in much the same way as do infrared and raman spectroscopy. The selection rules of tunneling are very weak; the spectrum observed consists of both the infrared and raman allowed vibrations. No experimental method is yet available that allows the complete determination of all reaction pathways on a catalyst surface. As a first step toward this ultimate goal we report the observation of the hydrogenation of CO chemisorbed on alumina-supported metal particles with tunneling spectroscopy. Inelastic Electron Tunneling Spectroscopy (IETS) measures the energies, and thus the frequencies, of the normal modes of vibration of molecules that are incorporated in order near the insulator of a metal-insulator-metal tunnel junction. In this work all junctions are made with an aluminum-aluminum oxide-dopant-lead structure, where the dopant consists of small metal particles (with 10-40 Angstrom diameters) that are exposed to CO and hydrogen. GRA

N81-17214# California Univ., Berkeley. Dept. of Mechanical Engineering.

AN EXPERIMENTAL INVESTIGATION OF THE INTERACTION BETWEEN A KARMAN VORTEX STREET AND A PREMIXED LAMINAR FLAME Ph.D. Thesis. Interim Report

Izak Namer Sep. 1980 115 p refs

(Contract F49620-80-C-0065; AF Proj. 2308)

(AD-A093419; UCB/FM-80-2; AFOSR-80-1325TR) Avail: NTIS HC A06/MF A01 CSCL 21/2

The interaction of a premixed C2H4-air flame with a Karman vortex street was studied. Laser Doppler anemometry was used for velocity measurements and Rayleigh scattering was used to measure total gas density. A reference hotwire was used to enable phase-locked ensemble averaging to be performed on the data. The velocity measurements, for vortex shedding cylinder Reynolds numbers 73 and 110, indicated that the vortex street and, hence, the flow field upstream of the flame is deflected by the flame. This is due to the pressure drop across the flame which is necessary to accelerate the flow behind the flame. The vortices were not observed behind the flame. The combination of dilatation and increased dissipation 'consumed' the vortices. Density statistics obtained from Rayleigh scattering measurements were compared with predictions by the Bray-Moss-Libby (B-M-L) model which neglects intermediate states. Density fluctuations were overpredicted by the B-M-L model by a small amount for 73 and 110. The flame was essentially a wrinkled-laminar flame for these conditions. GRA

N81-17215# International Business Machines Corp., Yorktown Heights, N. Y.

THE INTERACTION OF SILICON WITH A Pd (100) SURFACE

K. Christmann and J. E. Demuth 9 Dec. 1980 12 p refs Presented at the 5th Intern. Vacuum Congr., Cannes, France

(Contract N00014-77-C-0366; NR Proj. 056-123)

(AD-A093290; TR-14) Avail: NTIS HC A02/MF A01 CSCL 07/2

The interaction of silicon with a clean Pd(100) surface was studied in UHV using LEED, AES and UV-photoemission. Deposition around 75 C leads to disordered Si layers with little evidence of bulk diffusion or compound formation. Slight warming to about 150 C causes the immediate development of a complex LEED pattern indicative of long-range ordering. A pronounced splitting of the Si LVV Auger line as well as the appearance of a photoemission level about 2.5 eV below Ef is attributed to the formation of palladium (II) silicide, Pd2Si. Annealing at 250-500 C leads to decomposition of this silicide as indicated by the destruction of the complex LEED pattern and the disappearance of the Pd2Si Auger lines. Above 600 C diffusion of silicon into the bulk predominates which leads to a rapid depletion of silicon on the Pd surface as can be followed from both AES and UPS. GRA

N81-17216# International Business Machines Corp., Yorktown Heights, N. Y.

INTRINSIC STEP-RELATED SURFACE STATE ON Ir(332)

J. F. van der Veen, D. E. Eastman, and A. M. Bradshaw (Fritz Haber Inst., Berlin) 1 Dec. 1980 20 p refs Submitted for publication

(Contract N00014-77-C-0366; NR Proj. 056-123)

(AD-A093373; TR-13) Avail: NTIS HC A02/MF A01 CSCL 07/4

Using angle-resolved photoemission, we have identified a new surface state on Ir(332), which can be unambiguously associated with step sites. This state is located near the Fermi level and can be distinguished from a terrace-related state by preferential adsorption of hydrogen on the rows of step atoms. Both states have Lumbd symmetry and are located in a relative sp-hybridization gap above the L2 point. GRA

N81-17217# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.

SURFACE ENHANCED RAMAN SCATTERING FROM PYRIDINE ON Ag(111)

P. N. Sanda, J. M. Warlavmont, J. E. Demuth, J. C. Tsang, K. Christmann, and J. A. Bradley 27 Oct. 1980 20 p refs Submitted for publication

(Contract N00014-77-C-0366)

(AD-A093319; TR-10) Avail: NTIS HC A02/MF A01 CSCL 07/4

We report the first ultrahigh vacuum study of surface enhanced Raman scattering from pyridine adsorbed on a clean well defined single-crystal silver surface. The surface contains a smooth modulation (1 micron periodicity) to allow optical coupling to

surface plasmon polaritons. A large mode selective enhancement of the Raman signal from the first monolayer is observed at surface plasmon polariton resonance. GRA

N81-17218# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.
CHEMICAL REACTIONS AT THE METAL/SILICON INTERFACE Final Report, 1 Aug. 1979 - 31 Oct. 1980
G. W. Rubloff, P. S. Ho, and T. V. Tan 31 Oct. 1980 97 p refs
(Contract N00014-79-C-0932)
(AD-A093316) Avail: NTIS HC A05/MF A01 CSCL 07/3

This report includes the studies of Si(111) and Si(100) surfaces with Pd, Pt, Ni, and V metal overlayers leading to silicide formation. Experimental techniques utilized include ultraviolet photoemission spectroscopy, Auger electron spectroscopy, work function measurements and transmission electron microscopy. GRA

N81-17219# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.
HIGH RESOLUTION ELECTRON ENERGY LOSS AND SURFACE ENHANCED RAMAN STUDIES OF PYRIDINE AND BENZENE ON Ag(111)
J. E. Demuth, P. N. Sanda, J. M. Warlaumont, J. C. Tsang, and K. Christmann 27 Oct. 1980 45 p refs Submitted for publication
(Contract N00014-77-C-0366)
(AD-A093286; TR-12) Avail: NTIS HC A03/MF A01 CSCL 07/4

High resolution electron energy loss (EELS), UV photoemission, (UPS), low energy electron diffraction (LEED), Auger electron, and thermal desorption spectroscopic techniques have been applied to characterize the bonding, molecular orientation and vibrations of pyridine and benzene on clean Ag(111). These results are used to interpret the surface enhanced Raman spectra of these molecules adsorbed on a clean, well-defined single crystal Ag(111) surface containing a smooth periodic modulation (1 micron wavelength, approximately 500 A amplitude) which permits optical coupling to surface plasmons-polaritons. We observe enhanced Raman scattering (RS) for chemisorbed species only when we are at appropriate incidence angles so as to excite surface plasmons. Coverage dependent RS studies indicate a long range field enhancement of approx. 100 for physisorbed layers and a mode selective, short range enhancement of approx. 10,000 for the symmetric ring breathing mode of pyridine. This short range enhancement only occurs for pyridine coverages slightly above 3 x 10 to the 14th power molecules/sq cm where changes in the UPS spectra and our UPS derived uptake rates are also observed. Similar coverage dependent effects are also observed in UPS and EELS for chemisorbed pyridine on the ideal Ag(111) surface. These as well as LEED results showing the modulated surface to be predominately (approximately 90%) single crystal Ag(111), encourage us to directly compare the results obtained for the two surfaces. GRA

N81-17220# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Molecular Research Div.
ELECTRON MICROSCOPY ANALYSIS OF A SIMPLE METAL/CERAMIC INTERFACE
U. Dahmen, K. H. Westmacott, and G. Thomas Sep. 1980 23 p refs Presented at the 7th LBL/MMRD Intern. Mater. Symp., Berkeley, Calif., 28 Jul. - 1 Aug. 1980
(Contract W-7405-eng-48)
(LBL-11405; CONF-800765-3) Avail: NTIS HC A02/MF A01

High purity tantalum-carbon alloys were prepared and quenched in ultra-high vacuum and aged to produce large precipitates of the stable Ta2C carbide phase. In addition to determining the orientation relationship, diffraction contrast analysis and lattice fringe imaging techniques were employed to characterize the interface structures. DOE

N81-17221# Battelle Pacific Northwest Labs., Richland, Wash.
PRECIPITATION CHEMISTRY: ITS BEHAVIOR AND ITS CALCULATION
J. M. Hales Feb. 1980 65 p refs Presented at the Banff Intern. Conf. on Air Pollutants and Their Effects on the Terrest. Ecosystem, Alberta, Canada, May 1980
(Contracts DE-AC06-76RL-01830; EY-76-C-06-1830)
(PNL-SA-8418; CONF-800560-3) Avail: NTIS HC A04/MF A01

A rational basis is presented for examining the aggregate set of scavenging-calculation techniques and for guiding the reader in his course toward choosing the most appropriate technique for his particular application. A brief survey of current understanding of scavenging and precipitation chemistry is given. A flowchart approach is used which attempts to draw the various facets of scavenging calculations together and present a generalized approach to the problem in total. The mathematical level of this paper is restricted to the presentation of the equations necessary to provide the reader with a basic appreciation of the fundamental concepts involved. References to more detailed mathematical treatments are cited at appropriate juncture points, for the reader interested in more detailed pursuits. DOE

N81-17222# United Technologies Corp., East Hartford, Conn.
INVESTIGATION OF THE COMBUSTION CHARACTERISTICS OF FUEL DROPLET ARRAYS Final Technical Report
J. J. Sangiovanni Jun. 1980 72 p refs
(Contracts DE-AC22-78ET-13334; ET-78-C-03-2054)
(DOE/ET/13334-T1) Avail: NTIS HC A04/MF A01

The program was directed at establishing the nature and extent of droplet/droplet interaction and the multicomponent nature of real fuels on the ignition and combustion characteristics of spray flames. A unique free droplet combustion experiment provided the present investigation with a well controlled simulation of spray combustion. Various theoretical models were used. Experimental observations indicate that ignition delay times increase sharply by about three fold when droplet three fold when droplet spacings are reduced to less than five droplet diameters. Results of theoretical predictions indicate that as droplet spacing is made smaller, the effect of droplet/droplet interaction on ignition delay becomes increasingly more pronounced for small droplets, low gas phase temperatures, and fuels of low volatility. Although this result suggests that ignition of heavy grades of alternative liquid fuels will be inhibited in dense sprays, other theoretical and experimental results indicate that the addition of a small quantity of a volatile component to a heavy fuel shortens ignition times substantially. DOE

N81-17223# Wisconsin Univ., Madison. Dept. of Chemical Engineering.
IRON-INDUCED DEACTIVATION OF RANEY AND SUPPORTED NICKEL METHANATION CATALYSTS Semiannual Progress Report, 15 Sep. 1978 - 15 Sep. 1980
J. A. Dumesic May 1980 74 p refs
(Contract DE-FG21-78ET-1224; Grant ET-78-G-01-3380)
(DOE/ET-12248-T2) Avail: NTIS HC A04/MF A01

It was concluded that the deactivation of Ni/Al2O3 methanation catalysts is caused by particle size growth and surface site blockage (probably by carbon deposition). The particle size growth in Ni/Al2O3 methanation catalysts results from the formation of volatile Ni(CO)4, vapor phase transport and subsequent decomposition of Ni(CO)4. A region of safe operation conditions was found, and justified by thermodynamic equilibrium calculations. In situ Moessbauer spectroscopy was performed on a working iron catalyst at high pressure Fischer-Tropsch reaction conditions. It was clearly shown that under these reactions conditions: the top layer of a precipitated iron catalyst bed is present as a chi-carbide phase, and the bottom layer of a precipitated iron catalyst bed may contain appreciable amounts of magnetite, depending on the CO conversion. DOE

N81-17224# Bend Research, Inc., Oreg.
DEVELOPMENT OF COMPOSITE HOLLY FIBERS Final Report, Sep. 1977 - Mar. 1979
R. W. Baker, R. P. Barss, and H. K. Lonsdale Mar. 1980 46 p refs
(Contract DI-14-34-0001-7552)
(PB81-119554; W81-00200; OWRT-S-0017(7552)(1)) Avail: NTIS HC A03/MF A01 CSCL 07D

The feasibility of using inside skinned composite fibers for brackish water desalination via reverse osmosis was demonstrated. Composite hollow fibers potted in module with tube side feed was more resistant to fouling and less expensive than current module designs, partly because expensive pretreatment of the

feed was unnecessary and partly because the fibers were self supporting and did not require expensive pressure containment vessels. The performance compared favorably with current cellulose acetate brackish water membranes, and is superior to commercial brackish water hollow fiber systems. GRA

N81-17225# Boyle Engineering Corp., San Diego, Calif.
EVALUATION OF TECHNICAL MATERIAL AND INFORMATION FOR SEAWATER DESALTING DEMONSTRATION PLANTS Final Report
Aug. 1980 159 p refs Sponsored by Dept. of Interior
(PB81-118804; W81-00199; OWRT-C-00183-D(0453)(1))
Avail: NTIS HC A08/MF A01 CSCL 07A

The evaluation used eight criteria: interest and commitment; and considerations for general site, desalting needs, demographics and socio-economics, water supply, financial, energy, and environmental. Twenty sites located in thirteen states, the Mariana Islands, and the Virgin Islands were evaluated under these criteria. The sites were ranked by raw cumulative score. Sites with critical water needs were identified in both small and large cities. Comments were provided on the top ten ranked sites. The top ranked site to demonstrate single stage reverse osmosis (RO) desalination was Grand Isle, Louisiana. The second ranked site was Key West, Florida, partly since its water shortage has become more acute than two years ago. GRA

N81-17151* Naval Weapons Center, China Lake, Calif.
JANNAF WORKSHOP ON HAZARDS DUE TO PRECOMBUSTION BEHAVIOR OF HIGH ENERGY PROPELLANTS
T. L. Boggs *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 85-103 Conf. held at Eglin Air Force Base, 15-16 Apr. 1980 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17152* Los Alamos Scientific Lab., N. Mex.
DEFLAGRATION-TO-DETONATION TRANSITION IN GRANULAR HMX
A. W. Campbell *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 105-130 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17153* Illinois Univ. at Urbana-Champaign. Dept. of Aeronautical and Astronautical Engineering.
FLUID DYNAMICS OF THE UNSTEADY TWO PHASE PROCESSES LEADING TO DDT IN GRANULAR SOLID PROPELLANTS
H. Krier, P. B. Butler, and M. F. Lembeck *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 131-145 refs (For primary document see N81-17145 08-23)
(Grant AF-AFOSR-3335-77)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17154* Naval Weapons Center, China Lake, Calif. Detonation Physics Div.
BURNING-TO-VIOLENT-REACTION TRANSITIONS IN EXPLOSIONS
K. J. Graham and R. G. S. Sewell *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 147-177 refs Sponsored by the Navy Air Strike Warfare Program (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17155* Naval Weapons Center, China Lake, Calif.
THE ROLE OF GAS PHASE REACTIONS IN THE DEFLAGRATION-TO-DETONATION TRANSITION OF HIGH ENERGY PROPELLANTS
T. L. Boggs, C. F. Price, A. I. Atwood, D. E. Zurn, J. L. Eisel, and R. L. Derr *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 179-201 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17156* Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
EFFECT OF PROPELLANT DEFORMATION ON IGNITION AND COMBUSTION PROCESSES IN SOLID PROPELLANT CRACKS
M. Kumar and K. K. Kuo *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 203-238 refs (For primary document see N81-17145 08-23)
(Contract N00014-79-C-0762)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17157* Los Alamos Scientific Lab., N. Mex.
OBSERVATIONS OF LONG DELAYS TO DETONATION IN PROPELLANT FOR TESTS WITH MARGINAL CARD GAPS
Bart Olinger *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 239-244 ref (For primary document see N81-17145 08-23)
(Contract N00030-78-MD-78007)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17164* Southwest Research Inst., San Antonio, Tex.
PREDICTION OF INITIATION OF LOW AND HIGH EXPLOSIVE FILLERS DUE TO FRAGMENT OR PROJECTILE IMPACT
P. H. Zabel and V. B. Parr *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 321-333 refs Sponsored by AFSC (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

N81-17165* Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE INFLUENCE OF STRUCTURAL RESPONSE ON SYMPATHETIC DETONATION
Jerry L. Watson *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 335-354 ref (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21B

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N81-17226# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physical Metallurgy.
ENVIRONMENT SENSITIVE CRACKING OF AUSTENITIC STAINLESS STEELS Ph.D. Thesis
Hannu Hanninen 1980 25 p refs Prepared in cooperation with Technical Research Center of Finland, Espoo
(SF-02150) Avail: NTIS HC A02/MF A01

Only tensile stresses can cause stress corrosion cracking which can occur only in environments where electrochemical reactions can occur. A given alloy subjected to a corrosive environment under stress must also have an appropriate stress corrosion cracking sensitive structure. Current models of this environment sensitive cracking are surveyed with emphasis on the mechanics of crack initiation and crack propagation. Electrochemical dissolution and hydrogen induced cracking are discussed. Observations of fracture morphology in austenitic stainless steels using transmission electron microscopy and scanning electron microscopy support an embrittlement mechanism rather than anodic dissolution or electrochemical mechanical models. A.R.H.

N81-17227# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
XPS/AES STUDIES OF ALUMINUM FRACTURE SURFACES Final Report
B. L. Averbach 15 Nov. 1980 53 p refs
(Grant AF-AFOSR-2924-76; AF Proj. 2306)
(AD-A093131; AFOSR-80-1216TR) Avail: NTIS HC A04/MF A01 CSCL 11/6

X-ray photoemission (XPS, or ESCA) and Auger electron scattering (AES) studies were made of aluminum alloy surfaces after polishing, etching, and ion bombardment, and in the as-received condition. Surfaces obtained on fracture at 10 to the minus 10th power torr were also studied by means of scanning Auger microscopy (SAM). The materials studied were 2024-T351, 7075-T651 and high purity aluminum. Aluminum was found to exist in two chemical states at the surfaces of these materials. The Al 2p line of the XPS spectra was observed at 75.8 + or - 0.2 eV, corresponding to the oxide phase, for the as-received and the polished surfaces, and at 72.6 + or - 0.2 eV corresponding to metallic aluminum, for surfaces cleaned by prolonged argon-ion bombardment. Specimens which had been etched or partially cleaned by ion bombardment exhibited both peaks, separated by the chemical shift of 3.2 eV. A similar chemical shift, previously unreported, was observed for the Al 2s line, with the aluminum oxide line at 120.5 + or - 0.5 eV and the metallic aluminum line at 110.0 + or - 0.2 eV with a chemical shift of 2.5 eV. GRA

N81-17228# Missouri Univ. -Columbia.
STUDY OF CORROSION SPECIES AND INHIBITORS ON ALUMINUM BY INELASTIC ELECTRON TUNNELING SPECTROSCOPY Final Report, 10 Sep. 1977 - 9 Sep. 1980
H. W. White 4 Dec. 1980 7 p
(Contract DAAG29-79-C-0152; Grant DAAG29-77-G-0216)
(AD-A092998; ARO-14881.7-MS) Avail: NTIS HC A02/MF A01 CSCL 11/6

The technique of Inelastic Electron Tunneling Spectroscopy (IETS) has been applied to the study of corrosion and inhibition of corrosion of aluminum in the presence of organics. IETS spectra were measured and analyzed to obtain information on the intermediate and final corrosion species formed during the reaction of several chlorinated hydrocarbons with aluminum oxide surfaces. This information was coupled with previous corrosion and reaction results to develop reaction sequences and formulate corrosion mechanisms on a microscopic basis. Carbon tetrachloride and trichloroethylene were studied in detail. Studies on the inhibitor formamide provided information on the surface species formed, its orientation, and the types of sites with which it reacted. A comparison of experimental and theoretical intensities for formic acid adsorbed on aluminum was made in an attempt to make IETS a more quantitative tool for these kinds of studies. Model calculation for corrosion reaction mechanisms were also made and reported. GRA

N81-17229# Pennsylvania State Univ., University Park.
ENHANCED HIGH TEMPERATURE ADSORPTION IN TERNARY SYSTEMS Final Report, 21 Mar. 1977 - 20 Sep. 1980
G. Simkovich 25 Nov. 1980 17 p
(Grant DAAG29-77-G-0115)
(AD-A092997; ARO-14510.2-MS) Avail: NTIS HC A02/MF A01 CSCL 07/2

Adsorption was studied in the Fe-Cr-O system at 1313 K. H2/H2O atmosphere was utilized to control the oxygen pressures. Alloy compositions ranged from pure iron to chromium concentrations of 2 w/o. GRA

N81-17230# Paris VI Univ. (France). Lab. de Physique des Solides.
DEFECTS AND DISORDER PRODUCED BY ION IMPLANTATION IN SOLIDS Final Technical Report, Oct. 1977 - Oct. 1980
J. F. Morpange, G. Kanellis, and M. Balkanski Sep. 1980 73 p refs
(Grant DA-ERO-78-G-002; DA Proj. 1T1-61102-BH-57)
(AD-A092987) Avail: NTIS HC A04/MF A01 CSCL 07/4

Silicon and Gallium Arsenide samples doped by ionic implantation have been characterized by Raman spectroscopy. A specific behavior under laser annealing has been shown. This behavior can be explained by the presence of microcrystallites in the annealed region. A model describing vibrational properties of the microcrystallites has been established and compared with experimental results. GRA

N81-17231# Georgia Inst. of Tech., Atlanta. Fracture and Fatigue Research Lab.
THE EFFECT OF OVERLOAD ON FATIGUE CRACK PROPAGATION IN METASTABLE BETA TITANIUM-VANADIUM ALLOYS
Eui Whee Lee and Saghana B. Chakrabortty 28 Nov. 1980 39 p refs
(Contract N000140-75-C-0349; NR Proj. 031-75)
(AD-A093159; GIT-TR-80-1) Avail: NTIS HC A03/MF A01 CSCL 11/6

The crack retardation response due to single and multiple cycle overload of two titanium vanadium alloys (24 and 32 wt. pct. V) has been studied. it has been observed that the degree of retardation depends upon the vanadium content of the alloy, the load ratio, the number of overload cycles and the magnitude of the peak load. Fractographic observations show that the cracking mode may be changed in the overload affected zone from that in the preoverload region. These results seem to indicate that the retardation behavior is mainly due to the compressive residual stresses arising as a consequence of the overload. The degree of retardation depends not only on the loading variables, but also on the material parameters like the monotonic and cyclic deformation behavior, and the stress-strain response. GRA

N81-17232# Naval Ship Research and Development Center, Bethesda, Md.
MECHANISM OF SULFIDE-ACCELERATED CORROSION OF COPPER-NICKEL (90-10) ALLOY IN SEAWATER Final Report
Malcolm E. Schrader Dec. 1980 29 p refs
(ZR0220801)
(AD-A093951; DTNSRDC-80-127) Avail: NTIS HC A03/MF A01 CSCL 11/6

The mechanism of sulfide-induced accelerated corrosion of 90-10 copper-nickel (iron) alloy is investigated. Samples of the alloy are exposed to flowing (2.4 meters per second) seawater, with and without 0.01 milligrams per liter sulfide, for various periods of time. The resulting surfaces are examined by means of Auger electron spectroscopy coupled with inert-ion-bombardment. A detailed depth profile is thereby obtained of concentrations in the surface region of a total of nine elements. The results are consistent with the hypothesis that iron hydroxide segregates at the surface to form a protective gelatinous layer against the normal chloride-induced corrosion process. Trace sulfide interferes with formation of a good protective layer and leaves the iron hydroxide vulnerable to ultimate partial or complete debonding. When the alloy is first exposed to pure seawater for a prolonged period of time, however, subsequent exposure to sulfide is no longer deleterious. This is apparently due to a layer of copper-nickel salt that slowly forms over the iron hydroxide. GRA

N81-17233# Northwestern Univ., Evanston, Ill.
INTERACTION AMONG INHOMOGENEITIES Final Report, 15 Nov. 1976 - 30 Sep. 1980
T. Mura Dec. 1980 10 p refs
(Grant DAAG29-77-G-0042)
(AD-A093733; ARO-14127.17-E) Avail: NTIS HC A02/MF A01 CSCL 20/11

In this project, the basic research on inclusions and its application to inhomogeneities of materials has been sought. Interactions among precipitating particles, cracks, voids, and plastic domains have been investigated to obtain overall mechanical properties of materials. GRA

N81-17234# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
CHANGES IN RESIDUAL STRESSES DURING TENSION FATIGUE OF NORMALIZED AND PEENED SAE 1040 STEEL
M. McClinton and J. B. Cohen 1 Jan. 1981 25 p refs

(Contract N00014-80-C-0116; Grant NSF DMR-76-80847)
(AD-A093725; TR-3) Avail: NTIS HC A02/MF A01 CSCL 11/6

Appreciable compressive stresses develop during tensile fatigue (R-O) of normalized SAE 1040 steel, but only in or near regions of stress localization. These stresses develop in stages. After shot peening, the resultant compressive stresses are rapidly eliminated by tension-tension fatigue above the endurance limit, and replaced by tensile stresses. At lower stress levels, the induced stresses fade quickly. GRA

N81-17235# General Electric Co., Cincinnati, Ohio. Materials and Process Technology Labs.
CRACK GROWTH MODELING IN AN ADVANCED POWDER METALLURGY ALLOY Final Technical Report, 1 Sep. 1977 - 1 Feb. 1980
David A. Utah Jul. 1980 146 p refs
(Contract F33615-77-C-5082; AF Proj. 2420)
(AD-A093992; AFWAL-TR-80-4098) Avail: NTIS HC A07/MF A01 CSCL 11/6

An interpolative model has been developed to calculate the cyclic crack growth rate of an advanced aircraft engine disk alloy (AF115). The test variables included within the model consists of stress ratio, temperature, frequency, and hold time. The model was based on experimental results conducted within a statistically designed test program. A nonsymmetric Sigmoidal equation consisting of six independent coefficients was used to equate stress intensity range to cyclic growth rate. Two verification tests were conducted at two conditions other than those used during the development of the model to evaluate the model. GRA

N81-17236# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgy and Materials Science.
THE OMEGA-PHASE REACTION IN TITANIUM ALLOYS
T. W. Duerig, G. T. Terlinde, and J. C. Williams Feb. 1980 12 p refs
(Contract N00014-76-C-0409)
(AD-A093964; JWTR-6) Avail: NTIS HC A02/MF A01 CSCL 11/6

A morphological transition from ellipsoidal omega particles to cuboidal particles is reported to occur while isothermally aging in Ti-10V-2Fe-3Al. In light of this discovery, as well as others, the beta to omega reaction of beta stabilized Ti alloys is discussed. An isothermal growth mechanism which couples minor compositional fluctuations and lattice displacement waves is proposed. GRA

N81-17237# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgy and Materials Science.
STRESS ASSISTED TRANSFORMATION IN Ti-10V-2Fe-3Al
T. W. Duerig, R. M. Middleton (Army Materials and Mechanics Research Center), G. T. Terlinde, and J. C. Williams Feb. 1980 12 p refs Submitted for publication
(Contract N00014-76-C-0409)
(AD-A093965; JWTR-7) Avail: NTIS HC A02/MF A01 CSCL 11/6

A stress-assisted, or stress-induced reaction, is reported in the beta-Ti alloy - Ti-10V-2Fe-3Al. Both X-ray diffraction and electron microscopy are used to identify the products. The results indicate the product to be predominantly orthorhombic martensite (alpha double prime), with some mechanical twins. The structural nature of the beta yields alpha double prime transformation is discussed. The effects of the beta yields alpha double prime reaction upon mechanical properties is also discussed. GRA

N81-17238# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgy and Materials Science.
THE EFFECT OF HEAT TREATMENT ON MICROSTRUCTURE AND TENSILE PROPERTIES OF Ti-10 V-2 Fe-3Al
G. T. Terlinde, T. W. Duerig, and J. C. Williams Apr. 1980 14 p refs Submitted for publication
(Contract N00014-76-C-0409)
(AD-A093966) Avail: NTIS HC A02/MF A01 CSCL 11/6

In Ti-10-2-3 a variety of aged microstructures with different volume fractions and morphologies of primary and secondary alpha and also grain boundary alpha has been tensile tested. The results can be summarized as follows: (1) for a constant volume fraction of primary alpha, it is possible to vary the yield stress in a wide range; it is also possible to reach comparable yield stress levels for different volume fractions of alpha by an appropriate choice of aging temperatures and times as well as heating up rates to the aging temperatures; (2) increasing the volume fraction of primary alpha reduces the ductility at comparable yield stresses for the alpha-aged conditions. Only the beta-ST conditions with no primary alpha are an exception. They have lower ductilities than the (alpha - beta) ST conditions. The omega-aged microstructures have the lowest ductilities at comparable yield stresses; (3) the differences in ductilities between the (alpha - beta) ST and alpha-aged, the beta-ST and alpha-aged and the omega-aged microstructures are qualitatively related to different fracture modes; and (4) microstructures from a different forging which instead of the above tested globular primary alpha have elongated primary show lower ductilities at comparable yield stresses. GRA

N81-17239# Connecticut Univ., Storrs. Dept. of Metallurgy.
RESEARCH PROGRAM ON THE FATIGUE OF TITANIUM ALLOYS Final Report, 1 Oct. 1979 - 30 Sep. 1980
A. J. McEvily 30 Sep. 1980 16 p
(Contract F49620-79-C-0004; AF Proj. 2307)
(AD-A093802; AFOSR-80-1347TR) Avail: NTIS HC A02/MF A01 CSCL 11/6

A two year period of research on the fatigue characteristics of titanium alloys has been completed. Many of the aims of the program have been achieved. However, due to the late receipt of a large number of the test specimens, not all of the testing and study of the low cycle fatigue behavior investigations could be completed on schedule. Despite the extra costs involved, we expect to complete the test portion of the program by the end of 1980. Research on fatigue crack growth and the effects of overloads as well as a study of creep crack growth in a titanium alloy has been completed. GRA

N81-17240# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
DETERMINATION OF THE TRANSVERSE PROPERTIES OF ESR 4340 STEEL Final Report, 3 Aug. 1978 - 20 Jun. 1980
John T. Berry Sep. 1980 39 p refs
(Contract DAAG46-78-C-0045)
(AD-A093990; AMMRC-TR-80-48) Avail: NTIS HC A03/MF A01 CSCL 11/6

The objective of the present investigation is to determine the transverse engineering mechanical and fracture toughness properties of electroslag remelted high strength AISI 4340 steel in plate sizes 0.4 inch (10 mm), 1.0 inch (25 mm) and 1-7/8 inch (45 mm) and to correlate these properties with microstructural features. The results of the various tests (Double Ligament, Tensile, and Double Torsion) indicate that the difference between the longitudinal (X) and long transverse (Y) properties of heat 9060 (step-forged 1-7/8 and 1.0 inch plate portions) are at best minor in nature. The same is true with the 0.4 inch-thick cross-rolled ESR 4340 plate (heat 2780). The most significant property differences exist between X and Y direction properties on the one hand and those of through thickness (Z) direction on the other. On comparing the above results with data obtained for heat 9060 at other forging reductions, an increasing sensitivity of ductility (decrease) to increasing reduction is apparent in the Z direction. Scanning Electron Microscope work indicates that the degree of colonization present among the non-metallic inclusions present may be related to the range of ductility-related properties encountered in any particular orientation. GRA

N81-17241# Lehigh Univ., Bethlehem, Pa.
FACTORS AFFECTING THE CORROSION OF TIN IN THE PRESENCE OF REDUCIBLE INORGANIC AND ORGANIC SUBSTANCES Final Report, 1 Jul. 1977 - 30 Jun. 1980
Henry Leidheiser, Jr., Richard D. Granata, Alton Rauch, and Elhoseny M. Ibrahim 15 Dec. 1980 39 p refs
(Contract DAAG29-79-C-0016; Grant DAAG29-77-G-0178)
(AD-A093801; ARO-14918.1-MS) Avail: NTIS HC A03/MF A01 CSCL 11/6

The purpose of these studies is to obtain a better understanding of the role which antimony plays in accelerating the corrosion of tin. Tin-antimony alloys were prepared by electrodep-

osition and the corrosion rates were determined from polarization data obtained in deaerated 0.33M citric acid. The corrosion rates were linearly related to the antimony concentration in the alloy and could be described by the following equation: corrosion rate in A/sq. m. = 0.0003 - 0.000079X where X is the antimony concentration in the tin in ppm. Nitrite additions to the deaerated citric acid greatly accelerated the corrosion rate. The effect of nitrite could be described by the following equation: corrosion rate in A/sq. m. = 0.0003 - 0.021Y where Y is the nitrite concentration in the citric acid in ppm. The nitrite results and the great effect of antimony on the corrosion rate were attributed to the fact that a partially oxidized surface serves as a remarkably effective catalyst for the cathodic hydrogen evolution of tin. GRA

N81-17242# McDonnell Aircraft Co., St. Louis, Mo.
ENVIRONMENT-LOAD INTERACTION EFFECTS ON CRACK GROWTH IN LANDING GEAR STEELS Final Report, Aug. 1979 - Aug. 1980
C. R. Saff Oct. 1980 155 p refs
(Contract N62269-79-C-0275; WF41400000)
(AD-A093803; NADC-79095-60) Avail: NTIS HC A08/MF A01 CSCL 11/6

The objective of this program was to investigate chemical environment-load interaction effects on crack propagation. Dry air (+10 percent relative humidity) was used as a reference environment. Alternate immersion in synthetic sea water was used to simulate the aggressive chemical environment to which Navy carrier based aircraft are subjected. Tests were performed to determine the behavior of 300 M and HP-9-4-.30 steel in both environments under a variety of stress ratios and load wave shapes. A crack growth prediction capability developed through analysis and test accounts for environment and load interaction effects. A flight-by-flight test stress history was developed for a landing gear of a carrier based Navy aircraft. Crack growth predictions were prepared and tests performed to verify the chemical environment-spectrum loading analysis capability. A comparison of landing gear spectra under Air Force and Navy design conditions is presented. GRA

N81-17243# Rensselaer Polytechnic Inst., Troy, N. Y.
LIQUID METAL EMBRITTLEMENT OF AMORPHOUS ALLOYS Technical Progress Rport, 1 Jul. 1979 - 15 Sep. 1980
Norman S. Stoloss, Sankaranarayanan Ashok, Martin E. Glicksman, and Thomas Slavin 15 Sep. 1980 28 p refs
(AD-A093454) Avail: NTIS HC A03/MF A01 CSCL 11/6

Liquid metal embrittlement of four iron-base amorphous alloys has been demonstrated by means of tensile and bend tests. Fractographic features are shown to change markedly when fracture is accomplished under liquid metals. Similarities are noted between fractographic features in liquid metals and after hydrogen charging. The results are shown to be generally consistent with a model of adsorption-enhanced shear at crack tips by embrittling agents. GRA

N81-17244# Naval Ocean Systems Center, San Diego, Calif.
RESISTANCE OF COATED AND UNCOATED IR WINDOWS TO SEAWATER CORROSION, PHASE 4 Final Report, Oct. 1979 - Jun. 1980
J. D. Stachiw and S. L. Bertic (San Diego State Univ.) 1 Oct. 1980 45 p refs
(Contract N00123-80-D-0554)
(AD-A093799; NOSC/TR-587) Avail: NTIS HC A03/MF A01 CSCL 11/3

Germanium and chalcogenide glass specimens were submerged to a 35-foot depth in San Diego Bay for 130 days and the deterioration of their surfaces noted. The germanium specimens were coated either with multilayer antireflective infrared (IR) coatings, or with chalcogenide glass protective coating, while the chalcogenide glass specimens were tested bare. The submerged specimens were subjected to a forced water circulation at approximately 6-feet-per-second velocity to simulate actual operational scenarios to which a submarine-mounted IR window may be subjected. The chalcogenide AMTIR-1 glass specimens and the germanium specimens protected by the chalcogenide glass coating XF206 exhibited excellent corrosion resistance. The multilayer durable antireflection (AR) 40100 although not as corrosion resistant as chalcogenide glass coating, exhibited the best corrosion resistance of all AR coatings tested in this study. Other AR coatings on germanium deteriorated to different degrees. The severest deterioration took place on a germanium specimen covered with multilayer coating (XF204), but even there the transmission decreased only be approximately 5 percent, in the presence of many shallow (+ or = 0.010-inch) and few deep (+ or – 0.030-inch) corrosion craters in the surfaces of the germanium specimens. Carbon coatings, because of their potential resistance to seawater and abrasion, have been selected as the next class of coatings for evaluation in seawater environment. GRA

N81-17245# Battelle Columbus Labs., Ohio.
INVESTIGATING THE EFFECTS OF LOW TEMPERATURE ANNEALING OF AMORPHOUS CORROSION RESISTANT ALLOYS Final Report, 1 May 1977 - 31 Oct. 1980
R. B. Diegle and D. M. Lineman Nov. 1980 69 p refs
(Contract N00014-77-C-0488)
(AD-A093453; FR-3) Avail: NTIS HC A04/MF A01 CSCL 11/6

This research program was conducted in two phases. Annealing-induced changes in corrosion and mechanical properties of amorphous alloys were investigated during 1979-80, whereas earlier studies during 1977-1979 involved characterizing the localized corrosion resistance and feasibility of sputtering such alloys. Annealing, performed at temperatures up to that causing crystallization, produced embrittlement of $Fe_{32}Ni_{36}Cr_{14}P_{12}B_6$ at 100-200 C, as measured by bending. Embrittlement preceded crystallization, which initiated during a substantially higher temperature of 400 C. Annealing of $Fe_{32}Ni_{36}Cr_{14}Si_6B_{12}$ resulted in embrittlement at 300-400 C, which coincided with crystallization in this alloy. Segregation of phosphorus is believed to have caused embrittlement of the former alloy, whereas embrittlement of the latter was probably induced by crystallization. Susceptibility of both alloys to corrosion in chloride solutions increased dramatically with the occurrence of crystallization. This increase appeared as a reduction in the critical pitting potential with increasing degree of crystallization. Research performed during 1977-1979 showed that Fe-Ni-Cr-P-B alloys resist crevice corrosion as well as pitting. This observation was interpreted as indicating that even if initiation of localized corrosion is facilitated by introducing a crevice geometry, corrosion cannot proceed because of the considerable resistance of these alloys to propagation of attack. It was also demonstrated that these alloys can be sputtered as amorphous layers that exhibit essentially the same resistance to pitting corrosion as alloys of similar composition, but prepared by liquid quenching. GRA

N81-17246# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Metals Behavior Branch.
THE EFFECT OF DEFECTS ON THE FATIGUE INITIATION PROCESS IN TWO P/M SUPERALLOYS Final Report, Nov. 1977 - Nov. 1979
Jack M. Hyzak Sep. 1980 229 p refs
(AF Proj. 2307)
(AD-A093509; AFWAL-TR-80-4063) Avail: NTIS HC A11/MF A01 CSCL 11/6

A metallurgical investigation was performed to determine the effect of defect size, shape, and population on the fatigue initiation process in two high strength P/M superalloys, AF-115 and AF2-1DA. The specific alloy heats tested had contrasting defect populations; the AF-115 alloy contained a large population of spherical pores, and a lesser number of elliptical ceramic inclusions and plate-like hafnium oxide inclusions, and the AF2-1DA material contained only a small population of the elliptically shaped inclusions. Strain controlled fatigue tests were performed on uniform section specimens at 760 C, 649 C, and 22 C using both continuously cycling and cyclic dwell waveforms. Microscopic examination of the failed specimens showed that for the high temperature tests there was a transition in the nucleation site of the cracks that caused failure from a surface to a subsurface location as the strain range was reduced. This surface-subsurface transition (SST) occurred at approximately the same strain range for both alloys. GRA

N81-17247# Aluminum Co. of America, Alcoa Center, Pa. Alcoa Labs.
PRODUCTION OF ALUMINUM-SILICON ALLOY AND FERROSILICON AND COMMERCIAL PURITY ALUMINUM

BY THE DIRECT REDUCTION PROCESS. Annual Technical Report, 1 Sep. 1978 - 31 Dec. 1979
Marshall J. Bruno Oct. 1980 238 p refs
(Contract DE-AC01-77CS-40079)
(CONS-5089-10; ATR-2) Avail: NTIS HC A11/MF A01

A computer program was developed for simultaneously solving heat and mass balance at steady state for a flowing one dimensional chemical reactor. A bench reactor was designed, built, and operated to facilitate semicontinuous operation, using O2 injection to burn coke supporting the burden, resulting in burden movement. Validity of the equipment and test procedures was demonstrated by successfully operating the reactor as an iron blast furnace at 1500 C. Bench scale fractional crystallizer runs were continued to determine the impurity effects of Fe up to 6.9 percent and Ti up to 1.25 percent on alloy product purity and yield. High initial impurity concentrations resulted in less pure Al-Si product and product yield below 50 percent due to Al and Si losses as Fe-Si-Al and Ti-Si-Al intermetallics. Long term testing was continued in the large bench scale membrane cell to evaluate woven cloth membrane and other construction materials, operating procedures, and effects of operating parameters on cell performance. DOE

N81-17248# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
METAL PROCESSING RESEARCH Final Report, 16 Feb. 1978 - 30 Apr. 1980
F. J. Gurney and I. A. Martorell Aug. 1980 70 p refs
(Contract F33615-78-C-5003; AF Proj. 7351)
(AD-A093306; AFWAL-TR-80-4100) Avail: NTIS HC A04/MF A01 CSCL 11/6

This report summarizes the findings of research conducted on metal processing over a two year period. The research included the study of the occurrence of the central burst defect in 7075 Al, the effect of hydrogen on the flow stress of Ti6Al-4V and other titanium alloys (CP-Ti, Ti-5Al-2.5 Sn) and the design and use of a high sensitivity load cell. Information derived from this and past research was applied to the processing of numerous metal working operations of other alloys. GRA

N81-17249# Sandia Labs., Albuquerque, N. Mex.
THERMIONIC EMISSION IN REACTIONS OF ALUMINUM WITH SOME METALS AND THEIR OXIDES
V. A. Podergin, N. E. Glotov, and L. Kuznetsov 28 Aug. 1980 12 p refs Transl. into ENGLISH from Metalloterm. Protsessy Khim. Metall. Mater. Konf., Novosibirsk (USSR), Oct. 1971 p 152-157
(SAND-80-6022) Avail: NTIS HC A02/MF A01

The development of techniques to study thermionic emission of chemical reactions between aluminum and refractory metals of the transition groups and also with their oxides is described. When heated, these systems may be considered as systems comprised of an emitter (refractory metal, oxide) and aluminum particles adsorbed on the emitter surface. The experiments were carried out in a special furnace with an intermediate vacuum of 10 to the -2 through 10 to the -3 power mm Hg. Heating was accomplished at a rate of 10 deg/min up to 100 C. DOE

N81-17250# Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.
PROPAGATION OF STRESS CORROSION CRACKS IN ALPHA-BRASSES Ph.D. Thesis
Dennis Vinton Beggs 1981 190 p refs
(Contract DE-AC02-76ER-01198)
(DOE/ER-01198/1328) Avail: NTIS HC A09/MF A01

Transgranular and intergranular stress corrosion cracks were investigated in alpha brasses in a tarnishing ammoniacal solution. Surface observation indicated that the transgranular cracks propagated discontinuously by the sudden appearance of a fine crack extending several microns ahead of the previous crack tip, often associated with the detection of a discrete acoustic emission (AE). By periodically increasing the deflection, crack front markings were produced on the resulting fracture surfaces, showing that the discontinuous propagation of the crack trace was representative of the subsurface cracking. The intergranular crack trace appeared to propagate continuously at a relatively blunt crack tip and was not associated with discrete AE. Under load pulsing tests with a time between pulses, Delta t greater than or equal to 3 s, the transgranular fracture surfaces always exhibited crack front markings which corresponded with the applied pulses. Other significant results are reported. DOE

N81-17251# Hanford Engineering Development Lab., Richland, Wash.
MICROCHEMICAL EVOLUTION OF IRRADIATED STAINLESS STEELS
F. A. Garner 1980 25 p refs Presented at the Symp. on Irradiation Phase Stability, Pittsburgh, 5-9 Oct. 1080
(Contract DE-AC14-76FF-02107)
(HEDL/SA-2159; CONF-801072-3) Avail: NTIS HC A02/MF A01

The precipitates that develop during irradiation play the dominant role in the response of 300 series alloys, which alters not only the diffusional properties of point defects but also the rate of acceptance of point defects at dislocations and voids. The major elemental participants are carbon, nickel and silicon. Carbon appears to function as a major governing factor of the route and rate by which the radiation induced evolution proceeds. It is the sensitivity of carbon's response to a wide range of variables that accounts for much of the variability observed in the swelling of 316 stainless steel. Silicon's role is two fold: while in solution it depresses void nucleation and determines the duration of the void incubation period, and it also coprecipitates with nickel. The eventual level of nickel in the alloy matrix appears to control the steady state swelling rate and is determined by the silicon and carbon content. DOE

N81-17252# Aluminum Co. of America, Alcoa Center, Pa. Alcoa Labs.
PRODUCTION OF ALUMINUM-SILICON ALLOY AND FERROSILICON AND COMMERCIAL PURITY ALUMINUM BY THE DIRECT REDUCTION PROCESS. SPECIAL TECHNICAL REPORT: TECHNICAL FEASIBILITY OF COMBUSTION HEATED PROCESS FOR PRODUCING ALUMINUM-SILICON ALLOYS
Robert L. Troup Oct. 1980 19 p refs
(Contract DE-AC01-77CS-40079)
(CONS-5089-9) Avail: NTIS HC A02/MF A01

As part of a contract to develop a process for the carbothermic reduction of aluminum silicon alloys, the technical feasibility of an atmospheric combustion heated reactor was investigated. Potentially, such a reactor could have lower energy and capital requirements than current processes for producing aluminum and silicon. Reduction reactions were modeled using two chemical equilibrium computer programs which predicted the aluminum recovery in the reduction zone and the carbon rate needed to meet the energy requirements of the process. DOE

N81-17253# Aluminum Co. of America, Alcoa Center, Pa.
PRODUCTION OF ALUMINUM-SILICON ALLOY AND FERROSILICON AND COMMERCIAL PURITY ALUMINUM BY THE DIRECT REDUCTION PROCESS, PHASE C Interim Technical Report, 1 Jan. 1980 - 31 Mar. 1980
M. J. Bruno Oct. 1980 74 p refs
(Contract DE-AC01-77CS-40079)
(CONS-5089-11; ITR-1) Avail: NTIS HC A04/MF A01

Pilot reactor VSR-3 was operated with 75 to 120 SCFH O2 to supply part of the process heat requirements by combustion of coke. No alloy was made and burden bridging persistently stopped operations. Burning larger coke particles, -3/8 in. +6 mesh, with O2 injected through a larger diameter tuyere orifice resulted in oxygen attack on the reactor graphite liner. Updated thermochemical data for Al2O3 significantly changed the calculated reflux loading for a one atm blast furnace, predicting almost total reflux and no alloy recovery. Based on these calculations and the experimental problems with combustion heated operation, VSR-3 was modified to study an alternate reduction concept, the blast arc, which utilizes combustion heat to reduce SiO2 to SiC at 1600 C, and electrical heat to complete the reduction of Al2O3 and the production of alloy. Design, fabrication, and installation of most of the pilot crystallizer system was completed. DOE

N81-17254# Aluminum Co. of America, Alcoa Center, Pa. Alcoa Labs.

PRODUCTION OF ALUMINUM-SILICON ALLOY AND FERROSILICON AND COMMERCIAL PURITY ALUMINUM BY THE DIRECT REDUCTION PROCESS, PHASE C Interim Technical Report

Marshall J. Bruno Oct. 1980 62 p
(Contract DE-AC01-77CS-40079)
(CONS-5089-12; ITR-2) Avail: NTIS HC A04/MF A01

Beneficiation of bauxite by high intensity wet magnetic separation to remove Fe and Ti was not successful. Pilot reactor VSR-3 was modified and operated to evaluate the blast arc reduction process concept. Modifications, included a tapered upper shaft section, vertical stroke ram, and CO preheater system. The taper/ram revisions were successful in maintaining bed movement, resulting in several continuous runs in which large quantities of burden were fed and metal product was recovered. Pilot VSR samples were also analyzed. The major phases contained Si and FeSi2Al4 intermetallics in a matrix of eutectic Al-Si. DOE

N81-17255# Aluminum Co. of America, Alcoa Center, Pa.

PRODUCTION OF ALUMINUM-SILICON ALLOY AND FERROSILICON AND COMMERICAL PURITY ALUMINUM BY THE DIRECT REDUCTION PROCESS, PHASE C Interim Technical Report, 1 Jul. - 30 Sep. 1980

M. J. Bruno Oct. 1980 69 p refs
(Contract DE-AC01-77CS-40079)
(CONS-5089-13; IR-3) Avail: NTIS HC A05/MF A01

Pilot reactor VSR-3 operation in the third quarter was directed to tapping molten alloy product. Modifications to the hearth region included a tapping furnace to maintain taphole temperature, a graphite ring filter to separate carbides from matal and an alumina liner to eliminate carbiding from reaction of alloy with the graphite hearth walls. Tapping was not successful, however, due to high alloy viscosity from a large concentration of carbides. Three runs were made on the pilot crystallizer to determine the effects of alloy composition, cooling rate, tamping rate, remelt temperature and rate on eutectic Al-Si yield. DOE

N81-17256# Texas Univ., Houston. Dept. of Physics.

MICROSTRUCTURAL STUDIES OF HYDROGEN AND DEUTERIUM IN BCC REFRACTORY METALS Progress Report, 1 May 1979 - 31 Jul. 1980

Simon C. Moss 1980 15 p refs
(Contracts DE-AS05-76ER-05111; EY-76-S-05-5111)
(DOE/ER-05111-1) Avail: NTIS HC A02/MF A01

Over the past four years, this research has been principally concerned with uncovering the microstructural atomic arrangements in alloys of hydrogen and deuterium with bcc refractory metals. Because these are interstitial phases in which the host metal lattice is substantially deformed by the incorporation of the H(D) atoms, there are pronounced X-ray scattering effects. X-ray diffraction has, therefore, been the main structural tool. A main objective of the project was to determine the degree to which phase relations and solid solution properties in metal-hydride alloys depend upon the hydrogen-hydrogen interaction via the displacement field of the metal atoms. This has often included the elucidation of subtle thermodynamic properties which are revealed in structural studies. DOE

N81-17257# Flick (Cathy), Richmond, Ind.

TEMPERATURE AND PRESSURE DEPENDENCE OF THE RATE AND CHARACTERISTICS OF ALUMINOTHERMIC PROCESSES

A. S. Dubrovin, L. Kuznetsov, and Yu. Ya. Demidov 25 Sep. 1980 13 p refs Transl. into ENGLISH from Metalloter. Prot. Khim. Metal: Mater. Khim. (USSR), 1971 p 145-151 Prepared for Sandia Labs., Albuquerque, N. Mex.
(SAND-80-6023) Avail: NTIS HC A02/MF A01

The influence of temperature and external pressure on the recovery of the reducible elements in an ingot were investigated. Various metallothermic compositions were examined out in steel containers (diameter 60-mm, height 220-mm) lined with magnesite powder. The rate was measured from the time required for propagation of burning between thermocouples. R.C.T.

N81-17258# Brown, Boveri und Cie, A.G., Heidelberg (West Germany). Zentrales Forschungslabor.

DIRECTIONALLY SOLIDIFIED EUTECTIC SUPERALLOYS FOR STATIONARY GAS TURBINES Final Report

Peter R. Sahm and Uwe W. Hildebrandt Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 186 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-91; ISSN-0340-7608) Avail: NTIS HC A09/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 39.10

A stronger material (> 45 N/sqmm at 1000 C) presently used in gas turbine construction was developed based on Co-Cr7C3 directionally solidified eutectics. The thermodynamic phase stability as to the hexagonal-cubic transformation of the Co-Cr-C system was defined. Structural parameters were determined experimentally in consideration of each alloying element. Mechanical strength shows improvements up to 40% at 1000 C while creep rupture times are more than doubled compared with the basic Co-Cr7C3 eutectic. Cyclic against high temperature oxidation and corrosion is also obtained not only through alloying, but by applying Si-enrighed coatings.

Author (ESA)

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N81-17259* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PROCESS FOR THE PREPARATION OF FLUORINE CONTAINING CROSSLINKED ELASTOMERIC POLYTRIAZINE AND PRODUCT SO PRODUCED Patent

Robert W. Rosser and Roger A. Korus, inventors (to NASA) (San Jose State Univ.) Issued 30 Dec. 1980 5 p Filed 9 Apr. 1979 Supersedes N79-22301 (17 - 13, p 1698)
(NASA-Case-ARC-11248-1; US-Patent-4,242,498; US-Patent-Appl-SN-028300; US-Patent-Class-528-362; US-Patent-Class-528-401; US-Patent-Class-528-422; US-Patent-Class-528-423) Avail: US Patent and Trademark Office CSCL 07D

Crosslinking elastomeric polytriazines are prepared by a 4 step procedure which consists of (1) forming a poly (imidoylamidine) by the reaction, under reflux conditions, of anhydrous ammonia with certain perfluorinated alkyl or alkylether dinitriles; (2) forming a linear polytriazine by cyclizing the imidoylamidine linkages by reaction with certain perfluorinated alkyl or alkylether acid anhydrides or halides; (3) extending the linear polytriazine chain by further refluxing in anhydrous ammonia; and (4) heating to cyclize the new imidoylamidine and thereby crosslink the polymer.

Official Gazette of the U.S. Patent and Trademark Office

N81-17260* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CURING AGENT FOR POLYEPOXIDES AND EPOXY RESINS AND COMPOSITES CURED THEREWITH Patent

Tito T. Serafini, Peter Delvigs, and Raymond D. Vannucci, inventors (to NASA) Issued 13 Jan. 1981 5 p Filed 30 Aug. 1979 Supersedes N79-31345 (17 - 22, p2925)
(NASA-Case-LEW-13226-1; US-Patent-4,244,857; US-Patent-Appl-SN-070771; US-Patent-Class-260-37EP; US-Patent-Class-260-326S; US-Patent-Class-260-326N; US-Patent-Class-538-117; US-Patent-Class-528-118; US-Patent-Class-528-322) Avail: US Patent and Trademark Office CSCL 07C

A curing for a polyepoxide is described which contains a divalent aryl radical such as phenylene a tetravalent aryl radical such as a tetravalent benzene radical. An epoxide is cured by admixture with the curing agent. The cured epoxy product retains the usual properties of cured epoxides and, in addition, has a higher char residue after burning, on the order of 45% by weight. The higher char residue is of value in preventing release to the atmosphere of carbon fibers from carbon fiber-epoxy resin composites in the event of burning of the composite.

Official Gazette of the U.S. Patent and Trademark Office

N81-17261* National Aeronautics and Space Administration. Pasadena Office, Calif.

MOLTEN SALT PYROLYSIS OF LATEX **Patent**

Albert J. Bauman, inventor (to NASA) (JPL) Issued 20 Jan. 1981 5 p Filed 27 Apr. 1978 Supersedes N80-10361 (18 - *01, p0050) Sponsored by NASA*

(NASA-Case-NPO-14315-1; US-Patent-4,246,001; US-Patent-Appl-SN-900659; US-Patent-Class-44-62; US-Patent-Class-44-50; US-Patent-Class-201-8; US-Patent-Class-201-10; US-Patent-Class-201-25)

Avail: US Patent and Trademark Office CSCL 07C

Latex-rich plants such as Guayule or extracts thereof are pyrolyzed in an inert nitrogen atmosphere inorganic salt melts such as a LiCl/KCl eutectic at a temperature of about 500 C. The yield is over 60% of a highly aromatic, combustible hydrocarbon oil suitable for use as a synthetic liquid fuel.

Official Gazette of the U.S. Patent and Trademark Office

N81-17262* National Aeronautics and Space Administration. *Ames Research Center, Moffett Field, Calif.*

THE 1,2,4-OXADIAZOLE ELASTOMERS **Patent**

Robert W. Rosser, Ibrahim M. Shalhoub (San Jose State Univ.), *and Hanoi Kwong, inventors (to NASA) (San Jose State Univ.)* Issued 13 Jan. 1981 5 p Filed 9 Apr. 1979 Supersedes N79-22302 (17 - 13, p 1696)

(NASA-Case-ARC-11253-1; US-Patent-4,245,085; US-Patent-Appl-SN-028301; US-Patent-Class-528-310; US-Patent-Class-528-362; US-Patent-Class-528-401; *US-Patent-Class-528-422)* *Avail: US Patent and Trademark* Office CSCL 07D

Crosslinked 1,2,4-oxadiazole elastomers were prepared either by thermally condensing a monomer having the formula HwN(HON)C-R-Q, wherein Q is a triazine ring forming group such as nitrile or amidine, or by a mixture of said monomer with RC(NOH)NH22, with R in these formulas standing for a bivalent organic radical containing fluorine, hydrogen, or trifluoromethyl. In the monomer charge, the overall proportions of amidoxime groups to triazine ring forming groups varies depending on the extent of crosslinking desired in the final polymer. The heat and chemical resistant elastomers disclosed can serve, for instance, as adhesives, caulking compounds, channel sealants, fuel tank liners. Official Gazette of the U.S. Patent and Trademark Office

N81-17263*# Acurex Corp., Mountain View, Calif. Aerotherm Div.

SYNTHESIS OF IMPROVED PHENOLIC AND POLYESTER RESINS **Final Report**

C. B. Delano 27 Sep. 1980 79 p refs (Contract NAS3-22025)

(NASA-CR-165180; FR-80-42/AS) Avail: NTIS HC A05/MF A01 CSCL 07C

Thirty-seven cured phenolic resin compositions were prepared and tested for their ability to provide improved char residues and moisture resistance over state of the art epoxy resin composite matrices. Cyanate, epoxy novolac and vinyl ester resins were investigated. Char promoter additives were found to increase the anaerobic char yield at 800 C of epoxy novolacs and vinyl esters. Moisture resistant cyanate and vinyl ester compositions were investigated as composite matrices with Thornel 300 graphite fiber. A cyanate composite matrix provided state of the art composite mechanical properties before and after humidity exposure and an anaerobic char yield of 46 percent at 800 C. The outstanding moisture resistance of the matrix was not completely realized in the composite. Vinyl ester resins showed promise as candidates for improved composite matrix systems.

Author

N81-17264*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DYNAMICS OF SOLID DISPERSIONS IN OIL DURING THE LUBRICATION OF POINT CONTACTS. PART 1: GRAPHITE

C. Cusano (Illinois Univ., Urbana) and H. E. Sliney 1981 29 p refs Proposed for presentation at the Ann. Meeting of the Am. Soc. of Lubrication Eng., Pittsburgh, 11-14 May 1981

(NASA-TM-81683; E-410-1) Avail: NTIS HC A03/MF A01 CSCL 11H

A Hertzian contact was lubricated with dispersed graphite in mineral oils under boundary lubrication conditions. The contact was optically observed under pure rolling, combined rolling and *sliding, and pure sliding conditions. The contact was formed* with a steel ball on the flat surface of a glass disk. Photomicrographs are presented which show the distribution of the graphite in and around the contact. Friction and surface damage are also shown for conditions when the base oils are used alone and when graphite is added to the base oils. Under pure rolling and combined rolling and sliding conditions, it is found that, for low speeds, a graphite film can form which will separate the contacting surfaces. Under pure sliding conditions, graphite accumulates at the inlet and sweeps around the contact, but very little of the graphite passes through the contact. The accumulated graphite appears to act as a barrier which reduces the supply of oil available to the contact for boundary lubrication. Friction data show no clear short term beneficial or detrimental effect caused by addition of graphite to the base oil. However, during pure sliding, more abrasion occurs on the polished balls lubricated with the dispersion than on those lubricated with the base oil alone. All observations were for the special case of a highly-polished ball on a glass surface and may not be applicable to other geometries and materials, or to rougher surfaces.

Author

N81-17265*# National Aeronautics and Space Administration. *Lewis Research Center, Cleveland, Ohio.*

EVALUATION OF BOUNDARY LUBRICANTS USING STEADY-STATE WEAR AND FRICTION

William R. Loomis and William R. Jones, Jr. 1981 26 p *refs* Proposed for presentation at the 36th Ann. Meeting of the Am. Soc. of Lubrication Eng., Pittsburgh, 11-14 May 1981

(NASA-TM-81601; E-716) Avail: NTIS HC A03/MF A01 CSCL 11H

A friction and wear study was made at 20 C to establish operating limits and procedures for obtaining improved reproducibility and reliability in boundary lubrication testing. Ester base and C-other base fluids were used to lubricate a pure iron rider in sliding contact with a rotating M-50 steel disk in a pin-on-disk apparatus. Results of a parametric study with varying loads and speeds showed that satisfactory test conditions for studying the direction and wear characteristics in the boundary lubrication regime with this test device were found to be 1 kilogram load; 7 to 9 meters-per-minute (50 rpm) surface speed; dry air test atmosphere (less than 100 ppm H2O); and use of a time stepwise procedure for measuring wear. Highly reproducible steady-state wear rates resulted from the two fluid studies which had a linearity of about 99 percent after initially higher wear rates and friction coefficients during run-in periods of 20 to 40 minutes.

Author

N81-17266*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMMERICAL (TERRESTRIAL) AND MODIFIED SOLAR ARRAY DESIGN STUDIES FOR LOW COST, LOW POWER SPACE APPLICATIONS

Joseph C. Kolecki and Thomas J. Riley Dec. 1980 21 p *refs* (NASA-TM-81622; E-632) Avail: NTIS HC A02/MF A01 CSCL 10A

The suitability of commercial (terrestrial) solar arrays for use in low Earth orbit is examined. It is shown that commercial solar arrays degrade under thermal cycling because of material flexure, and that certain types of silicones used in the construction of these arrays outgas severely. Based on the results, modifications were made. The modified array retains the essential features of typical commercial arrays and can be easily built by commercial fabrication techniques at low cost. The modified array uses a metal tray for containment, but eliminates the high outgassing potting materials and glass cover sheets. Cells are individually mounted with an adhesive and individually covered with glass cover slips, or clear plastic tape. The modified array is found to withstand severe thermal cycling for long intervals of time. M.G.

N81-17267# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.

BOILING HEAT TRANSFER IN CONFINED SPACE **Annual Technical Report, 1 Aug. 1979 - 1 Aug. 1980**

Shi-chune Yao Sep. 1980 42 p refs (Contract N00014-79-C-0623)

(AD-A092973) Avail: NTIS HC A03/MF A01 CSCL 20/13

In many equipments, boiling occurs in confined space such as the clearance between the tube and the support plate of steam generators. Corrosive concentration builds up at the boundary of dryout zone and induces severe damage. The knowledge on this kind of boiling phenomena is very limited. It is the objective of this research to understand this fundamental heat transfer of this problem through systematical analysis and experimental studies. The forced convective two phase flow and boiling heat transfer in confined space is studied using the subchannel analysis which is an approximated method but effective in two phase calculations. Reasonable prediction of the dryout phenomena has been achieved. A separate analysis is performed for single phase flow heat transfer. This differential analysis is formulated from the lubrication theory and calculations are performed for both the line-contract or two-point contact configurations. Finally, the progress in experimental research is also reported here. GRA

N81-17268# Research Triangle Inst., Research Triangle Park, N. C.

DETERMINATION OF CROSSLINKING IN HIGH Tg POLYMERS Final Technical Report, 5 Oct. 1977 - 15 Oct. 1979

A. Schindler and N. Morosoff Wright-Patterson AFB, Ohio AFWAL Jul. 1980 94 p refs

(Contract F33615-77-C-5195)

(AD-A093820; AFWAL-TR-80-4085) Avail: NTIS HC A05/MF A01 CSCL 11/9

Considerable evidence has been accumulated by different investigators which demonstrates that the crosslink density in cured epoxy resins is not uniform. The non-uniformity of the network density can be so pronounced that the system approaches a two phase system being composed of a large number of densely crosslinked domains of globular shape (nodules or network clusters) which are imbedded in a common matrix of lower crosslink density. Most of the evidence for nodule formation in cured epoxy resins is derived from electron microscopic investigations of fracture surfaces by replication technique. Generally, the micrographs reveal the presence of globular domains with dimensions in the range of 10-70 nm. So far the existence of nodular structures could not be confirmed by X-ray scattering experiments. In view of the accumulated evidence for the presence of globular network inhomogeneities the lack of X-ray evidence would indicate an extremely small difference between the electron densities of nodules and imbedding matrix material. As a consequence the evaluation of X-ray particle scattering becomes experimentally rather demanding. GRA

N81-17269# Utah Univ., Salt Lake City. Dept. of Chemistry.

EFFECT OF THE CHAIN ALIGNMENT ON THE BRILLOUIN SCATTERING SPECTRA OF HYDROSTATICALLY EXTRUDED POLYPROPYLENE

David B. Cavanaugh and C. H. Wang 18 Dec. 1980 32 p refs

(Contract N00014-79-C-0507; Grant NSF DMR-79-12457)

(AD-A093222; TR-3) Avail: NTIS HC A03/MF A01 CSCL 11/9

A detailed Brillouin scattering study of hydrostatically extruded polypropylene at room temperature is carried out. The spectra obtained in various scattering configurations are used to determine the hypersonic velocity and elastic constants of the uniaxially deformed polycrystalline polymer. As polypropylene is extruded, C(33) increases rapidly with increasing extrusion, whereas C(11) decreases slightly. This result reflects the increasing alignment of the polymer chain segment along the direction of extrusion. The elastic constant C(13) decreases slightly, but C(44) does not undergo significant change as the sample is extruded, thus indicating that the shear modulus is insensitive to the orientation of chain segments in polycrystalline polypropylene. Comparison of the Brillouin scattering results with the ultrasonic values indicate that considerable frequency dispersion in the elastic constants is present. Calculation of the orientation parameter using Mosely's theory does not yield correct results. The discrepancy indicates that Mosely's model should be used with care. GRA

N81-17270# Utah Univ., Salt Lake City. Dept. of Chemistry.

BRILLOUIN SCATTERING STUDIES OF THE EFFECT OF ORIENTATION ON MECHANICALLY DEFORMED POLY (ETHYLENE TEREPHTHALATE)

David B. Cavanaugh and C. H. Wang 18 Dec. 1980 32 p refs

(Contract N00014-79-C-0507; Grant NSF DMR-79-12457)

(AD-A093222; TR-2) Avail: NTIS HC A03/MF A01 CSCL 11/9

Brillouin scattering is used as a tool for the study of the internal structure of oriented films of poly(ethylene terephthalate). Splitting in the longitudinal spectrum is observed as the film is stretched, indicating that the crystalline region is developed gradually from the amorphous region, and scattering from each region occurs independently. The hypersonic velocity data obtained from these two regions are used to draw directional maps of sound velocity propagating in different directions of the film. The orientational parameter in the amorphous phase is calculated from the hypersonic velocity data as a function of stretch ratio. The results are found in good agreement with the published values obtained by using a different technique. GRA

N81-17271# Columbia Univ., New York. Dept. of Chemistry.

INDUCTION OF OLEFIN METATHESIS BY ACETYLENES Technical Progress Report, 1 Aug. 1979 - 20 Nov. 1980

Thomas J. Katz, Stephen J. Lee, Mridula Nair, and Edward B. Savage 20 Nov. 1980 14 p refs

(Contract N00014-79-C-0683)

(AD-A092912) Avail: NTIS HC A02/MF A01 CSCL 07/3

Acetylenes induce (phenylmethoxycarbene) pentacarbonyltungsten to initiate metatheses of cis-2-pentene, cyclooctene, cycloheptene, and cyclopentene, but too much quenches the reactions. The first three of these transformations are remarkably stereoselective, yielding olefins that are 94 to 97% cis. These observations accord with the hypothesis that Scheme 1 is the mechanism of acetylene polymerization. They also provide a functional equivalent (an acetylene) of the organometallic cocatalysts like ethylaluminum dichloride, unique in operating in the absence of strong Lewis acid metal-halides. GRA

N81-17272# Columbia Univ., New York. Dept. of Chemistry.

STRUCTURAL AND DYNAMIC STUDIES OF MATERIALS POSSESSING HIGH ENERGY CONTENT Final Report, 1 Nov. 1977 - 31 Oct. 1980

Nicholas J. Turro 31 Oct. 1980 16 p refs

(Grant AF-AFOSR-3502-78; AF Proj. 2303)

(AD-A093213; AFOSR-80-1287TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

This final report updates and summarizes the research accomplished under this grant during the period of November 1, 1977 through October 31, 1980. We have emphasized investigations in the following areas: (1) reactivities and efficiencies of reaction of singlet oxygen with organic compounds; (2) reaction of singlet oxygen with strained organic molecules; (3) generation of singlet oxygen in a molecular beam; (4) generation and dynamic analysis of reactive diradicals, such as trimethylene methanes and carbenes in fluid solution. These studies are intended to advance our knowledge of the nature and behavior of excited molecules and their emission characteristics. We have elucidated the available mechanisms for producing excited molecules selectively and in high yield via chemiluminescent reactions. Our investigation of singlet oxygen chemistry and chemiluminescent reactions may lead to the development of novel chemical lasers and of means of protecting polymers against oxidative degradation. GRA

N81-17273# Naval Ship Research and Development Center, Annapolis, Md.

OUTGASSING OF SHIPBOARD LUBRICATING OILS Final Report

Peter Demas Dec. 1980 32 p refs

(ZF43451001)

(AD-A093274; DTNSRDC-SME-79-112) Avail: NTIS HC A03/MF A01 CSCL 11/8

The outgassing characteristics of three Navy lubricating oils were investigated to determine whether potentially toxic gases could be released in ships' atmospheres by their use. Lubricating oils studied were: (1) a diesel engine oil conforming to MIL-L-9000G(SHIPS); (2) a hydraulic and light turbine oil conforming to MIL-L-17672B; and (3) a refrigerant compressor

oil conforming to VV-L-825A. Single samples of each oil were sequentially exposed to temperatures of 50 C, 100 C, 250 C, and 450 C each for 3 hours, and the types and amounts of the outgassed products were determined. All were found to have low vapor pressure, an important factor in sustaining an uncontaminated atmosphere. The oils showed evidence of decomposition when heated above 135 C, 260 C, and 213 C, respectively, in the order mentioned. Decomposition was indicated by emission of a sulfur odor, discoloration, and formation of a burgundy-colored deposit. The aromatic contents of the oils were found to be low and, therefore, the probability of potentially hazardous polycyclic compounds appears to be low also. If any of these materials were heated above 100 C, some carbon monoxide, aldehydes, and sulfur dioxide would be produced; however, these substances would not be produced if the temperature did not exceed 100 C. This conclusion is based on data derived from single determinations on only a single oil of each type. GRA

N81-17274# Shell Oil Co., Houston, Tex.
COALINGA POLYMER DEMONSTRATION PROJECT Annual Report, Jul. 1978 - Jul. 1979
V. Schultz Sep. 1980 129 p refs
(Contracts DE-AC03-77ET-13001; EF-77-C-03-1556)
(DOE/SAN-1556/4; AR-4) Avail: NTIS HC A07/MF A01

A field demonstration test of displacement mobility control in the East Coalinga Field is being conducted in order to determine the relative merits of polymer flooding and waterflooding in a medium viscosity oil reservoir. The injection pattern consists of four invented 5 spot patterns and an updip area. Water injection began in June 1976 and continued through April 1978. Polymer injection began in May 1978 and is ongoing. The overall production performance for the pilot has been far less than expected. The current oil production rate is currently below the expected primary decline rate. The polymer injection rate is substantially below original predictions and will increase the time required to inject the designed slug volume. DOE

N81-17275# Propellants, Explosives and Rocket Motor Establishment, Waltham Abbey (England).
THE WEATHERING OF PLASTICS MATERIALS IN THE TROPICS. PART 5: POLYPHENYLENE OXIDE AND NORYL
Jan. 1980 54 p
(BR71961) Avail: NTIS HC A04/MF A01

The effect of long term weathering on polyphenylene oxide (PPO) and Noryl (a polystyrene modified PPO) was investigated. Both natural and carbon black containing samples of each were exposed for up to 4 years at two tropical and one temperate site. Visual appearance, weight, tensile and flexural strength, and electrical properties were recorded and used to monitor the effects of weathering. PPO embrittled within 6 months temperate exposure. Results indicate that the performance of Noryl is superior to PPO, but it is not expected to retain acceptable mechanical properties after prolonged exposure. Author (ESA)

N81-17276# DL Labs., New York, N.Y.
EVALUATION OF PROPERTIES OF ARCHITECTURAL COATING Final Report
Sidney B. Levinson, Saul Spindel, and Jerry H. Willner 22 Sep. 1980 57 p Sponsored by California State Air Resources Board 2 Vol.
(PB81-113565; DL-3028; ARB-R-80/129) Avail: NTIS HC A04/MF A01 CSCL 11C

The results of a project to evaluate the performance properties of recently developed water-based and low-solvent architectural coatings are presented to determine if these products have properties equivalent to the conventional high-solvent products which are now used for the same purposes. Architectural coatings are paints and related products applied to stationary structures such as buildings and plant facilities. The classes of coatings evaluated included clear finishes, opaque stains, metal primers, wall primers, wood primers, tile-like glazes, waterproof coatings, maintenance topcoats, swimming pool paints and mastic coatings. Some of the new products tested had performance properties equivalent to or better than the conventional high-solvent architectural coating products. GRA

N81-17277# DL Labs., New York, N.Y.
EVALUATION OF PROPERTIES OF ARCHITECTURAL COATING, APPENDICES Final Report
Sidney B. Levinson, Saul Spindel, and Jerry H. Willner 28 Aug. 1980 50 p Sponsored by California State Air Resources Board 2 Vol.
(PB81-113557; DL-3028-A) Avail: NTIS HC A03/MF A01 CSCL 11C

The test data and procedures of a project to evaluate the performance properties of recently developed water based and low solvent architectural coatings to determine if these products have properties equivalent to the conventional high solvent products are presented. The classes of coatings evaluated include clear finishes, opaque stains, metal primers, wall primers, wood primers, tile-like glazes, waterproof coatings, maintenance topcoats, swimming pool paints and mastic coatings. Some of the products tested had performance properties equivalent to or better than the conventional high solvent architectural coating products. GRA

N81-17278# PSC Professional Services Group, Inc., Narberth, Pa.
EVALUATION OF HIGHWAY CULVERT COATING PERFORMANCE Final Report, Jun. 1978 - Nov. 1979
W. T. Young Jun. 1980 161 p
(Contract DOT-FH-11-9425)
(PB81-115461; FHWA/RD-80/059) Avail: NTIS HC A08/MF A01 CSCL 11C

A literature search was conducted through a review of technical literature and interviews with cognizant state officials throughout the United States. The literature search revealed durability problems with the most commonly used materials and coatings. Most coatings exhibit durability problems under conditions of abrasive bed load and extreme corrosivity. Coating types examined at various test sites and actual drainage installations include: asphalt, asbestos bonded asphalt, asphalt paving, coal tar laminate, polyethylene, PVG, vinyl plastisol, aluminized, aluminum - zinc and epoxy coated concrete. GRA

N81-17279# Woods Hole Oceanographic Institution, Mass.
THERMAL CONDUCTIVITY MEASUREMENT OF FUSED SILICA GLASS
D. Goldberg, R. P. VonHerzen, and J. Sciater Aug. 1980 23 p refs
(Grant NSF OCE-79-09448)
(PB81-109985; WHOI-80-34) Avail: NTIS HC A02/MF A01 CSCL 11B

Laboratory measurements with the needle probe technique on chip samples of silica glass saturated with water gave a value of 3.287 + or - 0.154 (S.D) mcal/cm s C(n=21) at 25C, which is within about 1% of the previously determined values and the value given by the manufacturer for this material. The good agreement indicates that the flat plate steady state and needle probe transient methods give the same value for the material, and that the water saturated chip technique is an accurate method to measure thermal conductivity of isotropic samples. GRA

N81-17280# Brown Univ., Providence, R. I.
INELASTIC BEHAVIOR OF PLASTICS Final Report
J. H. Weiner Jul. 1980 19 p refs
(Contract GRI-5014-363-0147)
(PB81-114084; GRI-79/0056) Avail: NTIS HC A02/MF A01 CSCL 11I

Increased understanding of the mechanical behavior of plastics such as polyethylene was developed. Improved understanding of its mechanical behavior may permit improvements in fabrication and testing procedures which in turn should lead to greater service reliability and economy for ratepayers. Some of the mechanical behaviors were studied by the following ways: (1) Advanced computer simulation techniques were developed which represent macromolecules, either in solution or part of a network, as a dynamical system of linked rigid bodies which are in Brownian motion. (2) Theoretical contributions to the understanding of barrier crossing rates were made in both the classical and quantum regimes. (3) The importance of correlated motion in macromolecular dynamics was demonstrated. (4) The

dramatic difference in statistical behavior between rigid and flexible macromolecular models was demonstrated. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N81-17281# Exxon Research and Engineering Co., Linden, N.J. Products Research Div.

EFFECT OF REFINING VARIABLES ON THE PROPERTIES AND COMPOSITION OF JP-5 Final Report, Sep. 1978 - Feb. 1980

Martin Lieberman and William F. Taylor Nov. 1980 161 p refs

(Contract N00140-78-C-1491)

(AD-A093842; EXXON/RL2PE.80) Avail: NTIS HC A08/MF A01 CSCL 21/4

The primary objective of this program was to identify potential future problem areas that could arise from changes in the composition, properties and potential availability of JP-5 produced in the near future. The study employed a systems type approach, looking at the various processing trains used to make JP-5 in the U.S. and abroad, the types of crudes used with the different processing trains and the crude-processing interactions that might impact on the quality and potential availability of JP-5 produced in the near future. Analyses were made separately for the two major geographical regions (PADs) currently producing JP-5 for the U.S. Navy. Potential fuel problems concerning thermal stability, lubricity, low temperature flow, combustion, and the effect of the use of specific additives on fuel properties and performance were identified and discussed. GRA

N81-17282# Ogden Air Logistics Center, Hill AFB, Utah. Missiles, Airmunitions, and Weapons Div.

PROPELLANT SURVEILLANCE REPORT LGM-30 A AND B STAGE I, TP-H1011 Semiannual Report

John A. Thompson Nov. 1980 112 p Supported by AF

(AD-A093864; MAKPH-448(80)) Avail: NTIS HC A06/MF A01 CSCL 21/9

This report contains propellant test results from cartons of TP-1011 bulk propellant representing LGM-30 A and B First Stage Minuteman Motors. Testing was accomplished in accordance with MMWRBM Project M04046C-WNL01529. The purpose of testing was to determine and provide early warning of any serious degradation trends occurring in the propellant for service life predictions. An analysis of all parameters indicates that no potential problems are expected in the propellant for at least two years past the oldest data point. Data stored in the G085 System were plotted utilizing the IBM 360-65 Computer and CAL-COMP Plotter. The data range at any age can be found by suitable inquiry of the G085 System. Each point on the regression plot represents the mean of all samples at that particular age. The number of specimens at each point is indicated on the sample size summary sheet accompanying each regression plot or group of regression plots. GRA

N81-17283# Defence Research Establishment Valcartier (Quebec).

A CASTABLE COMPOSITE EXPLOSIVE: THE COEFFICIENT OF CUBICAL EXPANSION

C. Belanger, F. Bedford, and A. Ouellet Oct. 1980 32 p refs

(AD-A093648; DREV-R-4169-80) Avail: NTIS HC A03/MF A01 CSCL 19/1

The volume of a composite explosive (RDX/binder-83/17) has been measured at temperatures from 248 to 338 K using Archimedes' principle. The specimens were covered with a protective film specially developed to prevent the binder from dissolving in the fluid, a silicone oil. From the results the coefficient of cubical expansion of the explosive at 296 K is .000357/K as the mean of 15 measurements having a standard deviation of .0000066/K. A similar technique applied to an aluminum specimen whose coefficient is known gave a value about 2.0 percent too large. GRA

N81-17284# Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.

ALCOHOL FROM CELLULOSICS: THE AUTOHYDROLYSIS-EXTRACTION PROCESS

Morris Wayman 1980 10 p Presented at the 4th Intern. Symp. on Alc. Fuels Technol., Sao Paulo, Brazil, 5-8 Oct. 1980

(CONF-801030-2) Avail: NTIS HC A02/MF A01

A process for the preparation of glucose from cellulosics for alcoholic fermentation is described. The cellulosics discussed are hardwoods such as aspen and the eucalypts, bagasse, straws, and other agricultural crop residues. For good yields of alcohol, cellulosics require pretreatment before hydrolysis. An effective pretreatment is autohydrolysis, which consists of steaming the cellulosic raw material at about 200 C for about 20 minutes. This opens up the fiber, renders the hemicellulose soluble in hot water, and depolymerizes the lignin. When conditions are properly chosen, the lignin becomes readily soluble in dilute sodium hydroxide solution, from which it can be recovered as an active chemical by acidification. Steps in the basic process described are: (1) autohydrolysis; (2) hemicellulose extraction; (3) lignin extraction; (4) hydrolysis; and (5) clarification of the wood sugar solutions; and (6) fermentation distillation. DOE

N81-17285# Oak Ridge National Lab., Tenn.

LIFE SCIENCES SYNTHETIC FUELS PROGRAM AT OAK RIDGE NATIONAL LAB.

K. E. Cowser and C. R. Richmond 1980 27 p refs Presented at 20th Ann. Hanford Life Sci. Symp., Richland, Wash., 10 Oct. 1980

(Contract W-7405-eng-26)

(CONF-801039-3) Avail: NTIS HC A03/MF A01

The health and environmental issues of synthetic fuels technologies is summarized. The program objectives are discussed. Investigations underway on the chemical, physical, and biological properties of potentially hazardous products derived from coal conversion or shale oil and on the environmental aspects of these products are described. DOE

N81-17286# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).

PYROTECHNIQUE LOGIC (APPLICATIONS IN THE ARIANE LAUNCH VEHICLE) [LA LOGIQUE PYROTECHNIQUE]

P. H. Boeglin and J. R. Fauvel Paris 1979 7 p In FRENCH Presented at Congr. on Explosifs et Pyrotech.: Appl. Spatiales, Toulouse, 22-25 Oct. 1979

(SNIAS-792-422-101) Avail: NTIS HC A02/MF A01

The pyrotechnic systems of the Ariane launch vehicle are described. The Ariane destruction and separation system requires that a series of functions be fulfilled: destruction of the three stages, ignition of braking and accelerating rockets, the disposal of accelerating rockets after use, and the separation of 1/2 stages. The components used are described together with ways of improving performance. Author (ESA)

N81-17287# Foster Associates, Inc., Washington, D.C.

A STATISTICAL STUDY OF COAL SULFUR VARIABILITY AND RELATED FACTORS. DOCUMENTATION FOR THE COAL SULFUR VARIABILITY DATA BASE AND ANALYTICAL PROGRAM Final Report

George R. Warholic, John E. Morton, Yimin Ngan, James E. Spearman, and Yvonne Harris May 1980 254 p refs

(Contract EPA-68-02-2592)

(PB81-111593; EPA-450/5-80-008B) Avail: NTIS HC A12/MF A01 CSCL 05B

The data structure and the analytical program developed for a statistical study of coal sulfur variability and related factors are described. GRA

N81-17288# McMullen (John J.) Associates, Inc., New York, N.Y.

NATIONAL PETROLEUM RESERVE - ALASKA: MARINE TRANSPORTATION SYSTEM ANALYSIS Final Report

M. D. MacPherson Oct. 1980 486 p refs

(Contract DO-A01-78-00-3082; MA Proj. 2791-4072)

(PB81-105041; Rept-2791/4072-F; MA-RD-940-81013) Avail:

NTIS HC A21/MF A01 CSCL 21D

The analysis provides the transportation cost for icebreaking and ice strengthened surface tankers and LNG carriers over a range of ship sizes and propulsion power levels and for submarine tankers for each of a number of routes from four loading ports in the Arctic to discharge ports on the East and Gulf Coasts of the United States. The report includes discussions of the technical factors related to Arctic ship construction and operation, ice technology, and the environmental and institutional factors which must be included in an evaluation of an Arctic marine transportation system. GRA

N81-17289# McMullen (John J.) Associates, Inc., New York, N.Y.
NATIONAL PETROLEUM RESERVE - ALASKA: MARINE TRANSPORTATION SYSTEM ANALYSIS. EXECUTIVE SUMMARY
M. D. Macpherson Oct. 1980 25 p
(Contract DO-A01-78-00-3082; MA Proj. 2791-4072)
(PB81-105033; MA-RD-940-81012) Avail: NTIS
HC A02/MF A01 CSCL 21D

The analysis provides the transportation costs for icebreaking and ice-strengthened surface tankers and LNG carriers over a range of ship sizes and propulsion power levels and for submarine tankers for each of a number of routes from four loading ports in the Arctic to discharge ports on the East and Gulf Coasts of the United States. The technical factors related to Arctic ship construction and operation, ice technology, and the environmental and institutional factors which must be included in an evaluation of an Arctic marine transportation system are discussed. GRA

N81-17290# Katzen (Raphael) Associates, Cincinnati, Ohio.
FARM AND COOPERATIVE ALCOHOL PLANT STUDY: TECHNICAL AND ECONOMIC ASSESSMENT AS A COMMERCIAL VENTURE
Oct. 1980 241 p
(Contract NAFC-T-16076549)
(PB81-112641; NAFC-80-08) Avail: NTIS HC A11/MF A01 CSCL 21D

The production of motor fuel grade (MFG) ethanol in small plants was evaluated. Several parameters were explored as follows: six agricultural locations; three plant sizes of 90,000, 300,000, and 900,000 gallons per year; five feedstocks; ethanol proof levels of 190 and 199; and by-product distillers grains either as whole stillage or prepared by various degrees of drying. Plants were assumed to operate only 6000 hours per year (sugar beets only 3600 hours) because of limitations of time (or beet feedstock). Locally, available boiler fuels were chosen. Simplified processing was identified so as to be realistically within the time and experience available to a farmer operator. GRA

N81-17291# Institute of Gas Technology, Chicago, Ill.
EVALUATION OF COAL CONVERSION CATALYSTS Annual Report
Anthony L. Lee Gas Research Inst. Mar. 1980 16 p refs
(Contract GRI-5014-322-0139)
(PB81-111387; GRI-79/0077) Avail: NTIS
HC A02/MF A01 CSCL 21D

Three sulfur-resistant methanation catalysts were evaluated with feed mixtures simulating raw gasifier effluents for extended periods. These catalysts were evaluated at 200, 400, and 1000 psig; 500, 700, 800, 900, 1000, 1100, and 1200F; 2000, 3000, and 4800 Scf/hr-cu ft; using feeds containing sulfurs (H2S, COS, CH3SH, C2H5SH, and C4H4S) up to 3 mole percent. GRA

N81-17292# Institute of Gas Technology, Chicago, Ill.
HYDROGASIFICATION OF OIL SHALE Final Report, Jan. 1972 - Dec. 1979
Harlan L. Feldkirchner Gas Research Inst. Oct. 1980 495 p refs Sponsored by Gas Research Inst.
(IGT Proj. 30520; AGA Proj. 1U-4-7)
(PB81-114092; GRI-79/0064) Avail: NTIS
HC A21/MF A01 CSCL 21D

The technical and economic feasibility of producing synthetic pipeline gas from oil shale using the HYTORT Process were investigated. With Western shale, 95% or more of the organic carbon could be converted to useful products, and with Eastern shales organic carbon conversions up to 90% were achieved. In addition to showing the overall technical and economic feasibility of the process, this study showed the technical and economic feasibility of a novel, patented method for feeding shale to and from high-pressure reactors. Based on the results obtained, it now appears that the Eastern U.S. shale resource (largely neglected in the past because of the low yield by the conventional Fischer Assay method) is now economically recoverable. GRA

N81-17293# Institute of Gas Technology, Chicago, Ill.
RAPID-RATE BITUMINOUS COAL GASIFICATION Annual Report, 1 Jan. - 31 Dec. 1979
D. Q. Tran and A. R. Mikkelsen Gas Research Inst. Oct. 1980 27 p refs
(Contract GRI-5011-322-0082)
(PB81-114290; GRI-79/0074) Avail: NTIS
HC A03/MF A01 CSCL 21D

Cold flow model studies were conducted in a 91.4 cm testing tube to elucidate phenomena that cause divergence of coal particle trajectories and to define the optimum coal injector configuration. Results of these studies showed that it is essential to wet screen the crushed coal and that for particles in the range of 74 to 250 microns, the particle trajectories were laminar at nozzle Reynolds numbers of up to 30. For these Reynolds numbers, the results showed that coal particles in the size range 44 to 105 micrometer (-40+325 mesh) can achieve smooth streamline flow patterns over a free fall distance greater than 76.2 cm (30 in). Large particles, up to 250 micrometer (-60 mesh), achieve even greater laminar free fall distances exceeding 91.4 cm. GRA

N81-17294# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
PYROLYTIC OILS: CHARACTERIZATION AND DATA DEVELOPMENT FOR CONTINUOUS PROCESSING Progress Report, Jun. 1976 - Mar. 1980
J. A. Knight, L. W. Elston, D. R. Hurst, and R. J. Kovac Aug. 1980 199 p refs
(Grants EPA-R-804416; EPA-R-806403)
(PB81-110959; EPA-600/2-80-122) Avail: NTIS
HC A09/MF A01 CSCL 21D

Pyrolytic oils produced by the pyrolysis of forestry residues in a vertical bed, countercurrent flow reactor were thoroughly characterized. The pyrolytic oils were produced in a 500 lb per hour pilot plant and in a 50 ton per day field development facility. The overall chemical and physical properties were determined by standard analytical techniques. The oils are dark brown to black with a burnt, pugent odor and have a boiling range of about 100 C to approximately 200 C at which point thermal degradation begins to occur. Pyrolytic oils contained phenolics, pholythydroxy neutral compounds and volatile acidic compounds. GRA

N81-17295# Dayton Univ., Ohio. Research Inst.
OBTAINING IMPROVED PRODUCTS FROM THE ORGANIC FRACTION OF MUNICIPAL SOLID WASTE Final Report
N. L. Hecht, D. S. Duvall, A. A. Ghazee, and B. L. Fox Aug. 1980 126 p refs
(Grant EPA-R-804421)
(PB81-110918; EPA-600/2-80-121) Avail: NTIS
HC A07/MF A01 CSCL 21D

Several processes for the conversion of the organic fraction of municipal solid waste to a powder were investigated. The first phase was devoted to identifying processes that offer a potential for enhanced product recovery, an evaluation of chemical treatment to improve carbon recovery from pyrolysis processes, an evaluation of laboratory processes for the production of gaseous and liquid fuels, and a laboratory investigation of embrittlement processes for cellulose wastes. The second phase was concerned with further laboratory studies of the embrittlement process, pilot studies of the embrittlement process with shredded newsprint and refuse derived fuel, and an engineering and economic assessment for a plant to process powered cellulose for use as fuel. GRA

N81-17296# Catalytic, Inc., Philadelphia, Pa.
DEVELOPMENT OF CATALYSTS FOR COAL CONVERSION Annual Report, 1979

John Happel, M. A. Hnatow, and Bajars Liamonis Jan. 1980 24 p
(Contract GRI-5014-322-0145)
(PB81-111395; GRI-79/0115) Avail: NTIS HC A02/MF A01 CSCL 21D

A major breakthrough was accomplished in the development of a new family of catalysts. These formulations have such high activity in the presence of high concentrations of CO2 that they can be used in a process cycle to produce syngas with only one acid gas removal step. Steam consumption was reduced from that required in conventional methanation processes. Eighty-six new catalyst formulations and one hundred seventy-three reduction and evaluation tests were conducted. A wide variety of potential catalytic material was tested. The best catalysts were further tested at high pressure and with gas feeds simulating raw syngas from several different types of processes. GRA

N81-17297# General Electric Co., Philadelphia, Pa.
MARINE BIOMASS PROGRAM Annual Report for 1979
Alan N. Tompkins 17 Oct. 1980 115 p refs
(Contract GRI-5010-323-0014)
(PB81-113185; GRI-79/0079) Avail: NTIS HC A06/MF A01 CSCL 21D

Integrated processes for production and harvesting of seaweed in the ocean and conversion of that seaweed to methane at costs competitive on a commercial scale, with other alternate energy production system are discussed. Experimental data show that controlled cultivation of macroalgae is feasible, and that fuels can be derived from marine biomass feedstocks. Extensive work with Macrocystis indicated that it can be grown in the open ocean when fertilized by artificially upwelled deep ocean waters. Kelp thus derived was shown to be favorably suited to methane production by the process of anaerobic conversion. This report expands upon this data base with emphasis of the critical parameters associated with biomass yield and overall energy balance. GRA

N81-17298# General Electric Co., Philadelphia, Pa. Reentry Systems Div.
LAND BIOMASS PROGRAM Annual Report, Apr. - Dec. 1979
K. Jain Chicago, Ill. Gas Research Inst. Sep. 1980 88 p refs Sponsored by Gas Research Inst.
(PB81-113177; GRI-79/0055) Avail: NTIS HC A05/MF A01 CSCL 21D

The development of integrated processes including production, harvesting, and conversion, to produce methane from land-based crops that are cost-competitive with alternative sources of energy is discussed. A program plan based largely on short rotation farming of herbaceous and woody biomass is described. Significant land related issues such as suitability and availability of land, and system parameters such as biomass productivity, methane yield, feedstock cost, unit product cost, and overall system efficiency are reviewed. Sixteen candidate species of woody and herbaceous biomass were selected. Samples of these species were collected for composition analysis and to obtain experimental data on methane yields. GRA

N81-17158* Hercules, Inc., Magna, Utah.
WHAT'S WRONG WITH THE NOL CARD GAP TEST?
Billings Brown *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 245-256 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

N81-17159* Naval Surface Weapons Center, White Oak, Md.
THE NOL GAP TEST: PAST, PRESENT, AND FUTURE
Sigmund J. Jacobs and Donna Price *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 257-265 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

N81-17160* Los Alamos Scientific Lab., N. Mex.
A NUMERICAL STUDY OF THE NOL LARGE-SCALE TEST
Allen L. Bowan *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 267-275 refs (For primary document see N81-17145 08-23)
(Contract N00030-79-MD-790009)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

N81-17161* Naval Surface Weapons Center, White Oak, Md.
SHOCK SENSITIVITY OF ENERGETIC MATERIALS
K. Kim *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 277-288 refs (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

N81-17162* Naval Weapons Center, China Lake, Calif.
REPORT ON JANNAF PANEL ON SHOTGUN/RELATIVE QUICKNESS TESTING Progress Report
R. A. Gould *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 289-301 (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

N81-17163* Los Alamos Scientific Lab., N. Mex.
NUMERICAL CALCULATION OF SHOCK-INDUCED INITIATION OF DETONATIONS
G. E. Cort and J. H. M. Fu *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 303-320 refs Supported by DOE (For primary document see N81-17145 08-23)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

N81-17166* Hercules, Inc., Magna, Utah.
SYMPATHETIC REACTION TESTS AND ANALYSES
David E. Ricardson and Allen L. Bowman *In* NASA, Washington The 1980 JANNAF Propulsion Systems Hazards Subcomm. Meeting, Vol. 1 Dec. 1980 p 355-376 refs Prepared in cooperation with LASL (For primary document see N81-17145 08-23)
(Contracts N00030-74-C-0100; N00030-77-M-077002)
Avail: Chemical Propulsion Information Agency, Laurel, Md. CSCL 21I

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N81-17299# Naval Civil Engineering Lab., Port Hueneme, Calif.
SHRINKAGE-COMPENSATING CEMENT FOR AIRPORT PAVEMENT. PHASE 3: FIBROUS CONCRETES. ADDENDUM Final Report, Jan. 1979 - May 1980
John R. Keeton Sep. 1980 27 p refs
(AD-A092945; CEL-TN-1561-ADD; FAA-RD-79-11-ADD) Avail: NTIS HC A03/MF A01 CSCL 11/2

Details of a research study on shrinkage-compensating fibrous concrete for airport pavements are presented. A total of 77 slab-type prisms 1 sq ft and 4, 6, and 8 in. thick were subjected to shrinkage in 50% RH. Concrete mixes containing 5.5, 6.5, and 7.5 bags of shrinkage-compensating cement were used in the study. Fly ash was also used for better workability and later added strength. Fiber contents used were 1.0, 1.5, and 2.0% by volume of the concrete. Residual concrete compressive stresses are used as a basis for recommendation of transverse joint spacing of 150 ft for expansive fibrous concrete overlays. GRA

N81-17300# Naval Civil Engineering Lab., Port Hueneme, Calif.
ANTIFOULING MARINE CONCRETE Final Report, Jul. 1977 - Sep. 1979
C. W. Mathews Mar. 1980 41 p refs
(AD-A092899; CEL-TN-1573) Avail: NTIS HC A03/MF A01 CSCL 11/2

Various toxic agents were investigated for their ability to prevent the attachment and growth of marine fouling organisms on concrete. Three methods of incorporating antifoulants into concrete were also studied. Porous aggregate was impregnated with creosote and bis-(tri-n-butyltin) oxide (TBTO) and then used in making the concrete. Cuprous oxide, triphenyltin hydroxide (TPTH), and 2-2-bis-(p-methoxyphenyl)-1,1,1-trichloroethane (methoxychlor) were used as dry additives. Two proprietary formulations were applied as coatings on untreated concrete. Test specimens were exposed at Port Hueneme, Calif. and Key Biscayne, Fla. Efficacy of toxicants was determined by periodically weighing the specimens and the fouling organisms that became attached. Concrete prepared with an aggregate impregnated with a TBTO/creosote mixture demonstrated the best antifouling performance of those specimens exposed for more than 1 year. The two proprietary coatings and the concrete containing methoxychlor, TPTH, and cuprous oxide as dry additives have exhibited good antifouling properties but have been exposed for a shorter time. Also, the strength of concrete prepared using the toxicants was acceptable and the corrosion rate of reinforcing rods did not increase. The concentration of organotin compounds was essentially unchanged in a concrete specimen exposed 6-1/2 years in seawater. GRA

N81-17301# Battelle Columbus Labs., Ohio.
METRICATION OF MIL-HDBK-5C Final Report, 25 Apr. 1977 - 29 Aug. 1980
Paul E. Ruff Wright-Patterson AFB, Ohio AFWAL Aug. 1980 632 p refs
(Contract F33615-77-C-5036)
(AD-A093212; AFWAL-TR-80-4110) Avail: NTIS HC A99/MF A01 CSCL 05/2

The objective of this program was to develop a 'soft' metric MIL-HDBK-5 Handbook based upon the conversion of existing United States (U.S.) units to the metric system of measurement and to publish the metric version of MIL-HDBK-5 as an Air Force technical report. The approach was to convert existing MIL-HDBK-5 to the metric system by changing all U.S. units of measurement to equivalent metric units. As required by Reference (1), the metric system used was The International System of Units (SI). In making the metric conversion, the conversion factors listed in Reference (2) were utilized. In general, the rules for conversion and rounding delineated in Reference (2) were observed. However, some exceptions to these rules were taken. The Handbook contains two digit and three digit design values in Ksi units with two and three significant figures, respectively. In the conversion, some arbitrary decisions were made for practical reasons. For most mill products, the design values vary with thickness. Consequently, the room temperature design allowable property tables list design values according to thickness ranges. GRA

N81-17302# CTI-Cryogenics, Inc., Waltham, Mass.
CLOSED CYCLE CRYOCOOLER FOR LOW TEMPERATURE ELECTRONIC CIRCUITS. PHASE 1: CONCEPT STUDY Final Report
Nov. 1980 75 p refs
(Contract N00014-80-C-0465)
(AD-A093416) Avail: NTIS HC A04/MF A01 CSCL 13/1

The ultimate goal of the total program is to develop cryocoolers which operate at 4.2 K with a heat load of at least 10 milliwatts. The goal of this Phase 1 effort is to conduct a conceptual study of small, low power, very low magnetic signature, lightweight, efficient closed cycle cryocoolers suitable for use with superconductive and other low temperature electronic circuits and systems. For this initial phase, the cryocoolers are to produce 50 milliwatts at 10 K or less with electrical input power not to exceed 250 watts. This study has examined various thermodynamic approaches and modeling. Regenerator geometries have been examined and regenerator materials have been screened, selected, and evaluated. Several configurations have been evaluated. Preliminary vibration and magnetic signature analyses have been performed on the most promising concepts. Three primary concepts were selected. These are small Macor concept, a large Macor concept and a Nylon concept. All have input power requirements between 140 and 210 watts. The small Macor concept is recommended for Phase 2 design and development because of its small size, ceramic construction and higher operating speed. An integral drive is recommended. Conclusions are reached that the power goal is achievable as is the temperature fluctuation goal, but the vibration and magnetic signature goals require further definition and analysis. Other critical areas identified include helium permeation and ceramic residual iron. GRA

N81-17303# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Geotechnical Research Branch.
RESINS AND NON-PORTLAND CEMENTS FOR CONSTRUCTION IN THE COLD
Robert Johnson Sep. 1980 23 p refs
(DA Proj. 4A7-62730-AT-42)
(AD-A092952; CRREL-SR-80-35) Avail: NTIS HC A02/MF A01 CSCL 13/13

A laboratory investigation was conducted to assess the potential of some resins and non-portland cements for structural concrete at low temperatures. The resins investigated were urethane (non-hydrophilic), epoxy and polyester, as well as a polysulfide polymer. Two non-portland (modified) cements were also tested. The curability of the resins, when mixed with fine aggregate, showed that they had potential for low temperature use in the following decreasing order: urethane, polyester, and epoxy. Of the non-portland cement materials, mixed as individual neat slurries, one showed potential for low temperature use at -10 C (using 3.9 C water). GRA

N81-17304# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.
WAVE RESISTANCE OF HIGH-LENGTH-TO-BEAM SURFACE EFFECTS SHIPS Final Report
Richard T. Van Eseltine Dec. 1980 21 p refs
(AD-A093046; DTNSRDC-CMLD-80-19) Avail: NTIS HC A02/MF A01 CSCL 13/10

The ACVWAV computer program is used to investigate the wave resistance experienced by a pressure distribution moving at constant speed. Wave resistance coefficients at constant weight and pressure for various length-to-beam ratios are presented. Surface elevations are also computed. Recently there has been an interest in high length-to-beam multipurpose transport surface effects ships. The ACVWAV program can be used to aid in determining the resistance characteristics of such ships. It was used in this study to compute the wave resistance and surface elevations of a pressure distribution moving at constant speed U over calm water for some high length-to-beam ratios. This study is an example of how numerical techniques can aid in predicting the hydrodynamic performance characteristics of proposed ships. GRA

N81-17305# Societe Nationale Industrielle Aerospatiale, Paris (France).
THE BONDING OF MATERIALS: A LONG EUROPEAN EXPERIENCE [UNE LONGUE EXPERIENCE EUROPEENE: LE COLLAGE DES METAUX]
Georges Jube Assoc. Aeron. et Astronautique de France Jun. 1979 21 p refs In FRENCH Presented at Journees Jules Jarry, Jun. 1979
(AAAF-NT-79-27; ISBN-2-7170-0575-7) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

Based on experience gained in European industries, the advantages of assembly by bonding and the evolution of structural bonding technology are reviewed. Improvement in surface condition, increased effectiveness of structural stiffeners, and better hermetic qualities in the structures of reservoirs are mentioned. The fabrication of sandwich structures and the optimization of honeycomb construction techniques are discussed. Bonding agents covered include pastes, powders, and liquids as well as thin films of epoxy cement. Advances in the reduction of bonding pressure and temperature are cited along with improved resistance to corrosion. High temperature, and chemical attack.
Author (ESA)

N81-17306# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
OVERALL SAFETY ASSESSMENT OF MULTISTORY STEEL BUILDINGS SUBJECTED TO EARTHQUAKE LOADS. EVALUATION OF SEISMIC SAFETY OF BUILDINGS Final Report

Shih-Sheng Paul Lai Jun. 1980 285 p refs
(Grants NSF ENV-76-19021; NSF ENV-78-00658)
(PB81-111718; R80-26; NSF/RA-800204) Avail: NTIS HC A13/MF A01 CSCL 13M

A set of 140 earthquake records was used to assess the uncertainties involved in ground motion representation. Based on the method of spectral moments, key Kanai-Tajimi parameters were determined for the set of records. The statistics and interdependencies of these parameters were evaluated. The correlation between these K-T parameters, strong motion duration, peak ground acceleration, epicentral distance and local magnitude was investigated. Semi-empirical modifications were made to an existing random vibration solution for single-degree-of-freedom elastoplastic systems. Similar modifications were incorporated in an approximate multi-degree-of-freedom elasto-plastic random vibration methodology for shear beam systems, and its validity was assessed by a series of compatibility studies. By using the random vibration methodology, the degree of overall seismic safety was assessed quantitatively for several multistory steel buildings designed by different procedures. GRA

N81-17307# Iowa State Univ. of Science and Technology, Ames. Heat Transfer Lab.
HEAT TRANSFER CHARACTERISTICS OF TURBOTEC TUBING Final Technical Report
A. E. Bergles Jun. 1980 58 p refs Prepared in cooperation with Turbotec Products, Inc., New Britain, Conn.
(PB81-113862; ISU-ERI-AMES-81018; HTL-24) Avail: NTIS HC A04/MF A01 CSCL 13A

The thermal/hydraulic performance of Turbotec spirally fluted tubes was evaluated. The emphasis is on individual heat transfer coefficients for the inside and outside surfaces so that the designer can calculate the overall heat transfer coefficient for any type of heat exchanger. The data for Turbotec tubes are presented in terms of an envelope diameter so that direct comparisons can be made with the performance of smooth tubes. The specific flow conditions considered are free convection external flow, laminar internal flow, turbulent internal flow (including fouling), turbulent external flow, fluidized beds, vapor space condensation, and in-tube condensation. The Turbotec tubes exhibit large increases in performance for forced convection single-phase flow. GRA

N81-17308# Swedish Council for Building Research, Stockholm.
UNITED NATIONS SEMINAR OF EXPERTS ON BUILDING CODES AND REGULATIONS IN DEVELOPING COUNTRIES
Mar. 1980 89 p refs Seminar held in Taellberg and Stockholm, Sweden, 17-24 Mar. 1980
(PB81-114472; CHS/R-80-1; ISBN-91-540-3251-2; D18-1980) Avail: NTIS HC A05/MF A01 CSCL 13A

The Seminar explored ways in which governments and the international community might build upon the recommendations adopted by HABITAT: the United Nations Conference on Human Settlements. Effort concentrated on examining how building codes and regulations can be adapted to meet the basic needs of the poor. Programs for a graduated or a step-by-step improvement in the quality of life of the least advantaged on a continuous basis is recommended, thus ensuring that the total population can achieve an acceptable standard of living within a reasonable period of time. Within this framework, ten detailed recommendations were approved and are presented. GRA

N81-17309# National Bureau of Standards, Washington, D.C. Center for Fire Research.
FIRE INVESTIGATION HANDBOOK Final Report
Francis L. Brannigan, Richard G. Bright, and Nora H. Jason Aug. 1980 200 p refs Prepared in cooperation with Maryland Univ., College Park. Sponsored in part by Fire Administration, Washington, D.C.
(PB81-113482; NBS-HB-134; LC-80-600095) Avail: NTIS HC A09/MF A01 CSCL 13L

The handbook is a reference tool designed to be used by the beginning or by the experienced fire investigator. How each person uses this book will depend upon a particular need and level of experience. The broad areas covered are: fire ground procedures; post fire interviews; the building and its makeup; ignition sources; the chemistry and physics of fire and sources of information. The appendices have sections on how to organize an arson task force; the expert witness; independent testing laboratories; and selective bibliography. GRA

N81-17310# National Bureau of Standards, Washington, D.C. Center for Building Technology.
COMPARISON OF SELECTED CODES AND STANDARDS RELATING TO EXISTING RESIDENTIAL BUILDINGS Final Report
Patrick W. Cooke Jul. 1980 311 p refs
(PB81-120842; NBSIR-80-2081) Avail: NTIS HC A14/MF A01 CSCL 13M

The performance levels of older residential buildings generally do not comply with the standards for safety or function that are applied of new buildings. The extent to which seven codes vary among each other in establishing minimum requirements for life, health and safety in existing dwellings, the differing approaches provided by traditional housing codes in contrast to more recently developed rehabilitation guideline documents regarding performance levels, and the degree to which each code meets its intended goals of providing and maintaining human shelter, protection, and privacy is examined. The code provisions are compared and analyzed in sixteen major code areas (e.g., structural requirements, light and illumination, plumbing requirements, etc.). Various inconsistencies among code documents with respect to uniformity and irrational approaches in the historical development of code provisions are indicated. GRA

N81-17311# National Bureau of Standards, Washington, D.C.
DIMENSIONAL/NBS, VOLUME 64, NUMBER 7, SEPTEMBER 1980 Monthly Report
Sep. 1980 33 p refs
(PB81-113201; NBS-DIM-64-7) Avail: NTIS HC A03/MF A01 CSCL 14B

Several topics are briefly addressed including energy efficiency studies; voluntary product standards; I/O interface verification guidance; gas phase structure of sulfuric acid; didymium glass filters; and numerical control machine tools. GRA

N81-17312# National Bureau of Standards, Washington, D.C. National Measurement Lab.
CATALOG OF FEDERAL METROLOGY AND CALIBRATION CAPABILITIES: 1980 EDITION Final Report
Kathryn O. Leedy Sep. 1980 74 p Supersedes PB-297151 (PB81-108516; NBS-SP-546; LC-80-600148; PB-297151) Avail: NTIS HC A04/MF A01 CSCL 14B

Federal laboratories involved in metrology and calibration are listed. Included is the name of a person to contact at each laboratory telephone number and address. The capabilities of each laboratory are indicated in a tabular listing by agency. To provide geographical distribution, the laboratories are listed by States. In addition, the laboratories are shown on a map by coded number. Other references are described. GRA

N81-17313# Purdue Univ., Lafayette, Ind. Joint Highway Research Project.
MAINTENANCE METHODS FOR CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS Final Report
Eldon J. Yoder 14 May 1980 53 p refs Sponsored in part by Indiana State Highway Commission
(PB81-108797; JHRP-80-4; FHWA/IN/JHRP-80/4) Avail: NTIS HC A04/MF A01 CSCL 13B

Test sections were constructed on a section of 1-65 south of Indianapolis, Indiana to evaluate various maintenance techniques that might be adopted for this type of pavement. The road was stratified into similar sections using deflection, cracking and breakup as selection criteria. Maintenance methods used included concrete shoulders, undersealing, asphalt concrete overlay, subdrains at the pavement edge and various combinations of these methods. In every case the pavement was patched prior to installation of the maintenance. GRA

N81-17314# Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
VIBRATION OF BUILDINGS UNDER RANDOM WIND LOADS Ph.D. Thesis
Erdal Safak and Douglas A. Foutch May 1980 141 p refs

(Grants NSF ENV-77-07190; NSF PFR-80-02582)
(PB81-110066; Structural-Res-Ser-480; UILU-ENG-80-2013; NSF/RA-800120) Avail: NTIS HC A07/MF A01 CSCL 13M

A method for analyzing the three dimensional dynamic response of wind-excited buildings is presented. The wind and building modes used in the analysis are similar to those used for analyzing along-wind response. The coupled along-wind, across-wind and torsional vibrations are computered using random vibration techniques. The expected maximum translational responses and the and the torsional response are obtained. The objectives of this study were to identify which wind and structural properties influence the torsional response and to determine whether the predicted torsional responses are large enough to warrant extending the method to building type structures. Only buildings with a rectangular cross section and normally incident wind were considered. GRA

N81-17315# Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
SYNTHESIS REPORT: D-CRACKING IN PORTLAND CEMENT CONCRETE PAVEMENTS Civil Engineering Studies, Jul. 1979 - Mar. 1980
Steven R. Thompson, Mikael P. J. Olsen, and Barry J. Dempsey Jun. 1980 107 p refs Sponsored by DOT and Illinois State Dept. of Transportation
(PB81-104721; UILU-ENG-80-2014; Transportation-Eng-Ser-29; FHWA/IL-80/187) Avail: NTIS HC A06/MF A01 CSCL 13B

The mechanisms and testing procedures for D-cracking in portland cement concrete pavements are examined. Benefication procedures are also investigated. The three general responses to freezing in the aggregate/paste system include elastic accommodation, high internal pressure, and high external pressure. It is found that the critical aggregate parameters influencing D-cracking are degree of saturation, maximum particle size, permeability, porosity, and pore size distribution. Evaluation of present laboratory testing procedures indicated that the ASTM C666, VPI slow-cool, Mercury Porosimetry, and Iowa Pore Index Tests correlated the best with field performance of concrete with respect to D-cracking. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N81-17316*# National Scientific Labs., Inc., Falls Church, Va.
RF ENVIRONMENT SURVEY OF SPACE SHUTTLE RELATED EEE FREQUENCY BANDS
J. Simpson, B. Prigel, and J. Postelle 1 Nov. 1977 147 p refs Prepared in part for General Electric Co.
(Contract NAS5-23734)
(NASA-CR-160081; NSL-21-136) Avail: NTIS HC A07/MF A01 CSCL 20N

Radio frequency assignments within the continental United States in frequency bands between 121 MHz abd 65 GHz were surveyed and analyzed in order to determine current utilization of anticipated frequency bands for the shuttle borne electromagnetic environment experiment. Data from both government and nongovernment files were used. Results are presented in both narrative form and in histograms which show the total number of unclassified assignments versus frequency and total assigned power versus frequency. A.R.H.

N81-17317# National Aerospace Lab., Tokyo (Japan). Computer Center.
ON THE EXISTENCE OF PERIODIC TRAVELING WAVE SOLUTIONS TO NONLINEAR DISPERSIVE EQUATIONS
Toshiyuki Iwamiya and Tadayasu Takahashi Sep. 1980 8 p refs
(NAL-TR-625T) Avail: NTIS HC A02/MF A01

The existence of periodic travelling wave solutions to some nonlinear dispersive equations which are modified versions of the Korteweg-de Vries equation is considered. The existence problem is reduced to the problem of finding periodic solutions of a certain kind of ordinary differential equation and the solvability of the reduced problem is standard in detail. By applying the result obtained for the reduced problem to the original problem, conditions for the existence (as well as the nonexistence) of the periodic travelling waves are derived. It is shown that the travelling wave solutions of the regularized long wave equations are represented by means of the Weierstrasss functions. Author

N81-17318# Rome Air Development Center, Griffiss AFB, N.Y.
ANTENNA TECHNOLOGY FOR SPACE-BASED RADAR. PART 2: ESTIMATION OF BLOCKAGE SIDE-LOBE LEVELS FOR THE SPACE-BASED RADAR ANTENNA Final Report
Roland L. Fante and Hugh L. Southall Jul. 1980 22 p refs
(AD-A092990; RADC-TR-79-358-Pt-2) Avail: NTIS HC A02/MF A01 CSCL 17/9

Side-lobe levels due to blockage effect of the boom connecting the feed to the lens of the space-based radar antenna are estimated. Also, the effect of antenna stays on side-lobe levels is calculated. It is shown that side-lobe levels exceeding -50 dB are produced by the boom. GRA

N81-17319# Rome Air Development Center, Griffiss AFB, N.Y. Electromagnetic Sciences Div.
COMSTAR MILLIMETER-WAVE PROPAGATION MEASUREMENTS
Larry E. Telford Apr. 1980 43 p refs
(AF Proj. 4600)
(AD-A093026; RADC-TR-80-133) Avail: NTIS HC A03/MF A01 CSCL 20/14

The use of millimeter frequencies for Earth-to-space communication links will soon be a reality. It has been long known that precipitation will be a problem because of the relatively large attenuation caused by rainfall along the propagation path. Some of the latest experiments to provide needed propagation data have involved the COMSTAR Millimeter-Wave Beacons which were part of three synchronous orbit satellites launched by COMSAT Laboratories. The Propagation Branch of the Electromagnetic Sciences Division utilized these beacons to obtain attenuation ratio data at 19 and 28 GHz and phase dispersion data at 28 GHz. This report is a station report covering the 1 year measurement program and various theoretical analyses. The attenuation ratio data was in fair agreement with the theory; however, considerable variation was found at low attenuations. Phase dispersion measurements were in reasonable agreement with theory considering the small magnitude of the phase dispersion across a 1 GHz bandwidth at 28 GHz. From a practical point of view, for a given propagation path, the path attenuation will be very large before phase dispersion becomes a problem for most systems. GRA

N81-17320*# SRI International Corp., Menlo Park, Calif.
COHERENCE BANDWIDTH LOSS IN TRANSIONOSPHERIC RADIO PROPAGATION Topical Report, 4 Jan. - 31 Mar. 1980
Charles L. Rino, Victor H. Gonzalez, and Anne R. Hessing 21 Apr. 1980 42 p refs
(Contract DNA001-80-C-0077)
(AD-A093044; DNA-5338T) Avail: NTIS HC A03/MF A01 CSCL 20/14

In this report a theoretical model is developed that predicts the single-point, two-frequency coherence function for transionospheric radio waves. The theoretical model is compared to measured complex frequency correlation coefficients using data from the seven equispaced, phase-coherent UHF signals transmitted by the Wideband satellite. The theory and data are in excellent agreement. The theory is critically dependent upon the power-law index, and the frequency coherence data clearly favor the comparatively small spectral indices that have been consistently measured from the wideband satellite phase data. A model for estimating the pulse delay jitter induced by the coherence bandwidth loss is also developed and compared with the actual delay jitter observed on synthesized pulses obtained from the Wideband UHF comb. The results are in good agreement with the theory. The results presented in this report, which are based on an asymptotic theory, are compared with the more commonly used quadratic theory. The model developed

and validated in this report can be used to predict the effects of coherence bandwidth loss in disturbed nuclear environments. Simple formulas for the resultant pulse delay jitter are derived that can be used in predictive codes. GRA

N81-17321# Illinois Univ. at Urbana. Electromagnetics Lab.
WAVE TRANSMISSION THROUGH A SPHERICAL DIELECTRIC SHELL
S. W. Lee, M. S. Sheshadri, V. Jamnejad (JPL), and R. Mittra Nov. 1980 40 p refs
(Contract N00019-80-C-0284)
(AD-A093289; UIEM-80-10; UILU-ENG-80-2555) Avail: NTIS HC A03/MF A01 CSCL 17/9

We consider the transmission of a spherical electromagnetic wave through a dielectric shell. The two surfaces of the shell are spherical (either concave or convex), and their centers are arbitrarily located in relation to the source point. The field solution determined by the geometrical optics theory is given in a simple closed form. Special attention is given to the lens effect of the dielectric shell which converts the incoming spherical pencil into a focusing pencil. GRA

N81-17322# Texas Univ. at Austin. Geotechnical Engineering Center.
DEVELOPMENT OF A LARGE-SCALE TRIAXIAL TESTING DEVICE FOR WAVE PROPAGATION STUDIES Interim Report
K. H. Stokoe, D. P. Knox, J. M. Roesset, S. E. Kopperman, and C. Suddhiprakarn Nov. 1980 58 p refs
(Grant AF-AFOSR-0031-80; AF Proj. 2307)
(AD-A093400; GR80-10; AFOSR-80-1319TR) Avail: NTIS HC A04/MF A01 CSCL 08/13

Experimental and analytical studies have been undertaken to investigate the effects of the 3D state of stress on the characteristics of seismic waves in soil. The initial experimental studies involve testing instrumented cubes of dry sand where the principal normal stresses are controlled independently. Compressing (P) and shear (S) waves are generated on the sides of the sand cube and propagate through the body of the sand. Wave lengths and frequencies are in the range of 0.5 to 2.0 ft and 300 to 1000 Hz, respectively. Accelerometers embedded in the sand body are used to monitor wave arrivals and amplitudes from which propagation velocities and attenuation under the various states of stress are calculated. The design and fabrication of the experimental facilities are presented. A metal-walled cube has been constructed with rubber membranes to apply confining pressures. In the center of each wall are excitation ports where impulses are applied to excite P and S waves in the sand at shearing strains below 0.01 percent. Analytical studies have concentrated on evaluating the disturbance created by an accelerometer, considered as a rigid body, on the wave front travelling through the soil. Two different approaches have been considered: the boundary integral equation method and a finite element formulation. Results are presented. The work described herein represents the first step in a long-range program to investigate experimentally the dynamic behavior of soils under arbitrary states of stresses and to study analytically the most appropriate procedures to model this behavior. GRA

N81-17323# Pennsylvania State Univ., University Park. Applied Research Lab.
TIME-FREQUENCY HOP CODING BASED UPON THE THEORY OF LINEAR CONGRUENCES Final Report
E. L. Titlebaum (Rochester Univ.) 22 Oct. 1980 17 p refs
(AD-A093382; ARL/PSU/TM-80-210) Avail: NTIS HC A02/MF A01 CSCL 12/1

Time-frequency hop codes are developed based upon the theory of linear congruences. These codes can be used for multiuser radar and asynchronous spread-spectrum communications systems. A uniform upper bound is placed on the crosscorrelation function between any two elements of the code set. The upper bound is minimized by choice of BT-product and is shown to diminish as 2/N, where N is the number of elements in the code set. The size and position of spurious peaks in the autocorrelation functions are discussed. The results are extended to narrowband ambiguity functions. GRA

N81-17324# Ohio State Univ., Columbus. ElectroScience Lab.
A HYBRID METHOD OF MOMENTS TECHNIQUE FOR COMPUTING ELECTROMAGNETIC COUPLING BETWEEN TWO MONOPOLE ANTENNAS ON A LARGE CYLINDRICAL SURFACE
S. A. Davidson and G. A. Thiele Apr. 1980 91 p refs
(Contract N00014-78-C-0049)
(AD-A093305; ESL-710816-8) Avail: NTIS HC A05/MF A01 CSCL 09/5

The hybrid technique presented in this paper is a method for solving electromagnetic problems in which an antenna or other discontinuity is located on or near a conducting body, such as antennas on aircraft or ships. The technique solves these kinds of problems by properly analyzing the interaction between the antenna or scatterer and the conducting body. The hybrid technique accomplishes this by casting the antenna structure in a moment method format and then modifying that format to account for the effects of the conducting body via the geometrical theory of diffraction (GTD). The technique extends the moment method to handle many problems that cannot be solved by GTD or the moment method alone. In general, arbitrary radiators located on or near canonical shapes or combinations thereof can be solved using the hybrid technique. Electromagnetic parameters which the hybrid technique can solve for include the near and far fields, current distributions, impedances, and scattering data. In this paper, a transmitting and receiving monopole antenna, located on the surface of a perfectly-conducting circular cylinder, are analyzed to determine the amount of radiated power which arrives at the receiving antenna, after accounting for the reflection and curved surface diffraction effects of the conducting cylinder. GRA

N81-17325# Raytheon Co., Goleta, Calif. Electromagnetic Systems Div.
AGILE POLARIZATION FEED ARRAY FOR 3-D DOME ANTENNA Final Technical Report, 1 Oct. 1978 - 30 Sep. 1979
David T. Thomas, S. Douglas Bixler, Carl J. Lauer, and Michael J. Maybell Nov. 1980 109 p refs
(Contract N00014-78-C-0690; ONR Proj. 252-008)
(AD-A093214) Avail: NTIS HC A06/MF A01 CSCL 09/5

This final report describes an investigation of polarization agility for octave-bandwidth feed arrays in a 3D dome antenna system. Both studies and experimental investigations were performed on this program. The studies include analyses of the polarization needs of 3D dome antenna systems especially the feed array portion, and investigation of techniques for implementation, including octave-bandwidth, dual-polarization array elements and circuits for agile polarization. The experimental investigations have consisted of design, fabrication, and test of two small arrays of orthogonal notch elements and of a similar, linear-notch array. Both dual-polarization elements exhibit wide azimuth scan capability over at least an octave bandwidth. Beamwidths of the coincident-center notch element remain uniformly broad over the octave band. A bibliography is included which lists 7 references on polarization analysis, 23 references on elements, and 13 references on array performance. GRA

N81-17326# California Univ., Davis. Div. of Statistics.
ON CHARACTERIZING DISCRETE SIGNALS IN ADDITIVE NOISE: A UNIFIED TREATMENT Interim Report
Russell A. Boyles and Francisco J. Samaniego Jul. 1980 18 p refs
(Grant AF-AFOSR-3180-77; AF Proj. 2304)
(AD-A093146; TR-15; AFOSR-80-1163TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A characterization and classification result is established which applies to Binomial, Negative Binomial or Poisson signals in additive noise. The result unifies and generalizes three separate characterization results appearing in the recent literature. The distributions of discrete signals in additive noise have been characterized via systems of differential equations satisfied by their probability mass functions in a series of recent papers. These papers have dealt with signal distributions belonging to various discrete exponential families. The present result relies on a new and general parametrization of a discrete family of distributions which includes all discrete convolutions of Binomial,

Negative Binomial (Pascal) and Poisson distributions as special cases. The proof of our characterization and classification theorem differs radically from the individual proofs of the characterization results in the papers cited. Moreover, the theorem requires somewhat weaker assumptions than cummulatively contained in previous results. In particular, no moment conditions are required in the present results. GRA

N81-17327# Network Analysis Corp., Vienna, Va.
COMMUNICATIONS SUPPORT FOR NATIONAL FLIGHT DATA CENTER INFORMATION SYSTEM Final Report, 1979 - 1980
Washington DOT Nov. 1980 160 p refs
(Contract DOT-FA79WA-4355)
(AD-A093095; NAC/FR-3030/01; FAA-RD-80-116) Avail: NTIS HC A08/MF A01 CSCL 17/2

The National Flight Data Center/Information System (NFDC/IS) data communications requirements were analyzed to determine the technical feasibility and the most cost beneficial approach of NADIN support. The following conclusions were made: The most cost/beneficial approach to NADIN support of the NFDC/IS data communications requirements provides for the use of NADIN for interactive and message traffic and dedicated facilities for the point-to-point, source-to-sink batch traffic. The most significant aspect of NADIN support for the NFDC/IS data communications requirements is in providing the communications link between the NFDC host system and the external systems with which it must interface. GRA

N81-17328# Great Lakes Sciences, Inc., Amherst, N. Y.
TARGET GLINT SUPPRESSION TECHNOLOGY Final Technical Report, Apr. 1979 - Apr. 1980
A. J. Cecere, R. A. Padgug, M. D. Burns, and M. E. Bechtel
Griffiss AFB, N.Y. RADC Sep. 1980 93 p
(Contract F30602-79-C-0141; AF Proj. 4506)
(AD-A093155; GLS-80-05; RADC-TR-80-303) Avail: NTIS HC A05/MF A01 CSCL 17/9

The subject of target noise effects, such as radar glint and the analogous radar range measurement error, is addressed both theoretically and via computer simulation. A thorough analytic treatment for Rayleigh targets is presented, including optimum target noise reduction techniques and associated variances. Performance against representative aircraft and cruise missile models is also presented. GRA

N81-17329# Ford Aerospace and Communications Corp., Palo Alto, Calif.
BROADBAND LINEAR COMMUNICATIONS AMPLIFIER Interim Report, Sep. 1977 - Sep. 1980
Pang T. Ho Griffiss AFB, N.Y. RADC Oct. 1980 61 p
(Contract F30602-77-C-0189; AF Proj. 4519)
(AD-A093143; RADC-TR-80-330) Avail: NTIS HC A04/MF A01 CSCL 09/5

Under this program an X-band, 5 watt linear solid state amplifier was designed, fabricated, and tested. The amplifier delivers saturated output power of 10 watt with power gain of 32 dB at 8 GHz. For linear amplification, the third order intermodulation distortion of the amplifier is -32 dBc at 5 watt (two-tone) output power level. The overall dc to RF conversion efficiency is 11% at saturation with total power consumption of 92.5 watts. GRA

N81-17330# Weapons Systems Research Lab., Adelaide (Australia).
FREQUENCY WAVENUMBER BEAMFORMING BY USE OF THE TWO DIMENSIONAL FOURIER TRANSFORM
D. A. Gray Jul. 1980 36 p refs
(AD-A093067; WSRL-0162-TR) Avail: NTIS HC A03/MF A01 CSCL 17/2

The concept of frequency wavenumber beamforming of a linear array of equispaced receivers is reviewed. The frequency wavenumber spectrum can be evaluated by using a two dimensional Fast Fourier Transform and the properties of the resulting estimate of the frequency wavenumber spectrum are described. Particular attention is given to the distortion of the spectral power estimates due to leakage of negative frequency components. GRA

N81-17331# Army Military Personnel Center, Alexandria, Va.
FOURIER TRANSFORMATION THEORY FOR AVERAGED FUNCTIONS, WITH APPLICATION TO VERY LONG BASELINE RADIO INTERFEROMETRY M.S. Thesis
Robert John Bonometti Feb. 1981 207 p refs
(AD-A093792) Avail: NTIS HC A10/MF A01 CSCL 17/9

This thesis investigates the effects on brightness function resolution when the visibility function is truncated and averaged. The causes of truncation and averaging (which arise in cases where satellites are incorporated as interferometer elements) are presented and the basic Fourier transform relation between the visibility and brightness functions is reviewed. The standard Fourier transform method, which is based on a generalization of the Sampling (or Nyquist) theorem and does not account for the effects of truncation and averaging, is presented. The effects of truncation and averaging are illustrated for a double Gaussian model source using the standard Fourier inversion method. Theorems concerning the Fourier transformation of a truncated and/or averaged visibility function are then developed and an algorithm based on this study is developed. This algorithm attempts to enhance resolution by using a derived relationship between an average value of the visibility function and the true source brightness function. The algorithm is applied to several one-dimensional test cases to illustrate its potential. GRA

N81-17332# Harris Corp., Melbourne, Fla.
RAPID ACQUISITION OF SPREAD SPECTRUM SIGNALS Final Report, 29 Oct. 1979 - 28 Oct. 1980
M. J. Bouvier, Jr., H. E. Walls, and R. W. Boyd Dec. 1980 178 p refs
(Contract DAAG29-80-C-0005)
(AD-A093800; Rept-1634-8019; ARO-17105.1-A-EL) Avail: NTIS HC A09/MF A01 CSCL 17/4

This investigation has focused on the fundamental principles of the acquisition process, mathematically quantifying potential acquisition performance as a function of receiver structures and devices, spreading waveforms and specially structured acquisition signals. Certainly the most obvious conclusion is that MF devices offer a relatively straightforward means (for DS systems at least) of achieving two to three orders of magnitude improvement in acquisition time. These magnitudes of improvement are quite significant for reacquisition operations in which only coarse or fine timing uncertainties exist. In addition, acquisition with a MF results in the smallest residual timing uncertainty at the completion of the acquisition process. Therefore, every attempt should be made to exploit this rapidly developing technology, especially for application to DS data links which require both rapid reacquisition and precision ranging capabilities. A specific recommendation for further work in this area is presented. GRA

N81-17333# Mission Research Corp., Albuquerque, N. Mex.
AIRCRAFT EMP ISOLATION STUDY Final Report
A. Finci, H. Price, P. Chao, S. Mercer, and T. Naff Kirtland AFB, N. Mex. AFWL Jul. 1980 97 p refs
(Contract F29601-78-C-0082; AF Proj. 1209)
(AD-A093772; AD-E200630; AFWL-TR-79-156) Avail: NTIS HC A05/MF A01 CSCL 20/14

This report presents the results of a preliminary study into methods for electrically isolating the E-4B, the EC-135, and the EC-130 aircraft during EMP tests where the aircraft under test is directly driven by a high-voltage pulser. GRA

N81-17334# University Coll., London (England). Dept. of Electronic and Electrical Engineering.
DESIGN CONSIDERATIONS FOR PHASED ARRAY MODULES Final Technical Report, 1 Mar. 1977 - 30 Sep. 1979
John R. Forrest, J. Austin, A. A. deSalles, and J. G. Schoenenberger Nov. 1980 418 p
(Grant AF-AFOSR-3238-77; AF Proj. 2305)
(AD-A093499; RADC-TR-80-354) Avail: NTIS HC A18/MF A01 CSCL 17/9

The report describes work carried out on the design of X-band (10 GHz) transmit/receive modules for use in active phased array radar. A heterodyne phase locked loop is used to synchronize the R.F. source in each module to a common reference. Beam steering for an array of modules is accomplished by phase shifting the intermediate frequency reference to each module, thus avoiding

the use of microwave phase shifters. An eight element array of modules was constructed and beam steered radiation patterns are given in the report. A particularly simple digital control and monitoring system for the R.F. phase shifters is described. Finally, the design and construction of the modules in microwave integrated circuit form with 10W pulsed Gunn diodes is described. GRA

N81-17335# Lexington Labs., Inc., Cambridge, Mass. Group 37.
THE SHIFT AND SCALE INVARIANT FOURIER-MELLIN TRANSFORM FOR RADAR APPLICATIONS
Lyle H. Johnson 14 Oct. 1980 55 p refs
(Contract F19628-80-C-0002)
(AD-A093690; RST-5; ESD-TR-80-197) Avail: NTIS HC A04/MF A01 CSCL 17/9

Automatic classification of targets viewed by radar is complicated by variations in target aspect relative to the radar line of sight (RLOS). This report investigates the possibility of reducing the effects of target aspect by using the scale invariance of the Mellin transform. The properties of the Mellin transform are developed in analogy with the Fourier transform and illustrated using simple test functions and digitally implemented transforms. Simulated radar ship profiles demonstrate that a change in aspect is not equivalent to a change in target scale for realistic targets, however. Automatic classification results, for both simulated and actual radar ship profiles, confirm that using a combination Fourier-Mellin transform for feature selection appears at best comparable to the results obtained using the Fourier transform alone for feature selection. GRA

N81-17336# CNR, Inc., Needham, Mass.
RADIO FREQUENCY MODELING OF AUDIO FREQUENCY SYSTEMS Final Technical Report, Sep. 1978 - 1979
James W. Graham, Charles J. Boardman, and William Welch Griffiss AFB, N. Y. RADC Oct. 1980 91 p refs
(Contract F30602-78-C-0142; AF Proj. 2338)
(AD-A093491; RADC-TR-80-331) Avail: NTIS HC A05/MF A01 CSCL 09/3

The results of an effort to develop techniques for radio-frequency modeling at frequencies to 500 MHz of audio-frequency systems and their nonlinear response to amplitude-modulated excitation are reported. The approach involves investigation of a test amplifier to guide the modeling effort and to provide a means for validation measurements. The amplifier is conductively excited between its metal case and ground as well as at normal input terminals. Special techniques to avoid excitation of indeterminate external modes were explored. In addition to high-frequency models of electronic components with parasitic elements, it was necessary to develop wideband RF models for shielded ferrite-core low-frequency inductors. It was also necessary to include models of the printed-circuit etch. The physical geometry of component and printed circuit layout played a significant role in the model development. The detection process for demodulation of amplitude-modulated radio carrier excitation was modeled in terms of the second-order nonlinear transfer function. GRA

N81-17337# Naval Research Lab., Washington, D. C.
ENVIRONMENTAL CONSTRAINTS IN EARTH-SPACE PROPAGATION
John M. Goodman 20 Nov. 1980 56 p refs Presented at the NATO-AGARD Conf. on Propagation Effects in Space/Earth Paths, London, May 1980 Sponsored by Navy
(AD-A093643; NRL-MR-4339) Avail: NTIS HC A04/MF A01 CSCL 22/2

The advantages of utilizing space for telecommunications is well known in both the commercial and military arenas. A small complement of satellites at synchronous orbit, for example, may provide nearly global coverage and may be designed to support small disadvantaged customers as well as those characterized by large antenna structures and sophisticated acquisition and processing capabilities. Modern navigational and timing needs can also be satisfied through exploitation of space platforms and NAVSTAR/GPS is a system which exemplifies the utilization of space for those purposes. Applications of space in surveillance and kindred areas also exist and spaceborne instruments for monitoring the exoatmospheric environment and transmissions from the Sun abound. There is an obvious charm in the utilization of space for various purposes, however, most applications require the transmission of intelligence or data between space platforms and other space segments or a ground terminal. Thus the channel or the propagation path clearly becomes a part of the total system as a perturbation source. The nuisance value of the propagation path derives from the extent to which it does not duplicate free space at a specified frequency. This paper reviews the general utilization of space to introduce the importance of Earth-space radio propagation with special emphasis directed toward DoD mission areas. An outline of the basic properties of Earth-space RF propagation follows and finally an assessment of the major effects is given. GRA

N81-17338# Communications Research Centre, Ottawa (Ontario). Radar and Communications Technology Branch.
THEORY OF CONICAL-SCAN RADARS FOR LOW-ANGLE TRACKING
J. Litva Aug. 1980 37 p refs
(AD-A093638; CRC-1336) Avail: NTIS HC A03/MF A01 CSCL 17/9

In this report, a description of the tracking behavior of conical-scan radars with low-angle targets is presented. To begin, an equivalence is established between monopulse and conical-scan radars. Transformations are then developed from this equivalence, which permit one to treat a conical-scan radar as an equivalent monopulse radar. An example is given of the use of these transformations for simulating the low-angle tracking behavior of conical-scan radars. The simulated result is compared with a low-angle conical-scan radar measurement. Since approximations are made in developing the theory presented in this report, a discussion is given on the range of tracking parameters for which the theory is valid. GRA

N81-17339# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
PASSIVE TARGET DETECTION MEASUREMENTS AT 220 GHz Interim Technical Report
M. L. Foster, R. E. Forsythe, J. M. Welch, and J. M. Schuchardt Aug. 1980 65 p
(Contract DAAK70-79-V-0108)
(AD-A093682) Avail: NTIS HC A04/MF A01 CSCL 17/9

Passive target signature measurements were performed at 220 GHz and 95 GHz. Test results show target detection is possible even with very warm sky temperatures. A 220 GHz/94 GHz sensor was used to detect a metallic vehicle at a range of 300 meters during the summer. Using a raster scan format, scans were made above, through and below the target. The scene thus viewed included trees and grass. Measurements were also made of the overhead sky and calibrated hot and cold radiometer. GRA

N81-17340# Defense Communications Engineering Center, Reston, Va. Transmission Engineering Div.
ATTRIBUTES FOR TIMING FOR A DIGITAL DCS
Harris A. Stover Jul. 1980 21 p refs
(AD-A093647; DCEC-EP-1-80) Avail: NTIS HC A02/MF A01 CSCL 17/2

In the future when the DCS becomes predominantly digital, employing time division multiplexing and/or switching, a system timing capability must be provided. In a complex digital DCS under wartime conditions, timing is difficult to achieve. As a basis to evaluate the effectiveness of different timing approaches, a set of desired attributes is needed. Suggested attributes with reasons for each are given. GRA

N81-17341# Washington Univ., Seattle. Dept. of Electrical Engineering.
TROPOSPHERIC EFFECTS ON MILLIMETER WAVE PROPAGATION Final Technical Report, 1 Dec. 1976 - 15 Mar. 1980
Akira Ishimaru Nov. 1980 25 p refs
(Contract F19628-77-C-0045; AF Proj. 2305)
(AD-A093260; UW-EE-TR-219; RADC-TR-80-291) Avail: NTIS HC A02/MF A01 CSCL 20/14

The final report gives a summary of all the work completed and under way under this contract covering the period from December 1976 to March 1980. The work covers a broad spectrum including radiometric determination of rain attenuation,

wideband millimeter wave communication, effects of transmitter and receiver characteristics, backscattering from turbulence and scatterer, diffusion of pulse in scatterer, and beam waves in random media. The emphasis is directed towards generating new ideas and techniques to solve practical problems. Success in our effort is evidenced by the list of reports and publications.
GRA

N81-17342# IIT Research Inst., Annapolis, Md.
A SUPPLEMENTARY EMC ANALYSIS OF THE PROPOSED AIRPORT SURFACE DETECTION EQUIPMENT (ASDE-3) RADAR
G. Larry Brown Aug. 1980 30 p refs
(Contracts F19628-78-C-0006; DOT-FA77WAI-778)
(AD-A092965; ECAC-CR-80-044; FAA-RD-80-123) Avail: NTIS HC A03/MF A01 CSCL 17/9

This report supplements information in an earlier report which identified electromagnetic compatibility (EMC) problems associated with the deployment of Airport Surface Detection Equipment (ASDE-3) Radars at a number of proposed sites in the United States. Subsequent to the earlier study, several operational parameters of the ASDE-3 radar have been modified in a direction to lessen the probability of causing or receiving interference, thereby necessitating a reanalysis of portions of the earlier study. As before, interferring signal levels are compared against established receiver thresholds to determine operational compatibility and frequency management techniques are identified as a solution to potential interference cases, where applicable. GRA

N81-17343# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
GAIN FUNCTION DISTORTION OF LINEAR ANTENNA ARRAYS DUE TO LARGE VARIATIONS IN ELEMENT POSITIONS
O. Schmid and C. vonWinterfeld Nov. 1979 25 p refs In GERMAN; ENGLISH summary
(Contract BMVg-GF-78/79)
(Rept-9/79) Avail: NTIS HC A02/MF A01

Theory leading to the calculation of gain function distortion for linear arrays of isotropic radiators experiencing statistical variations in the positions of their elements is presented. The numerically evaluated gain functions apply to a simple distortion model which gives a qualitative estimate of the antenna behavior. The results are further explained by the introduction of equivalent fields whose incursion on the antenna field of an undisturbed group array produces the same distortion behavior as a perturbation in radiator position. Author (ESA)

N81-17344# Graz Univ. (Austria). Inst. fuer Nachrichtentechnick und Wellenausbreitung.
THE INFLUENCE OF PRECIPITATION ON INTERFERENCE IN RADIO LINKS ABOVE 10 GHz: MEASUREMENT RESULTS AND THEORETICAL INVESTIGATION [UEBER DEN EINFLUSS VON NIEDERSCHLAEGEN AUF DIE DAEMPFUNG VON RICHTFUNKVERBINDUNGEN OBERHALB 10 GHz: MESSRESULTATE UND THEORETISCHE UNTERSUCHUNGEN]
R. Lang Sep. 1979 143 p refs In GERMAN; ENGLISH summary
(INW-7805/B) Avail: NTIS HC A07/MF A01

Terrestrial radio links in the frequency ranges 11 GHz and 20 GHz were monitored for atmospheric attenuation interference. These wavelengths are on the same order of size as the diameters of hydrometeors (raindrops, snowflakes, etc.) which are known to cause significant attenuation and depolarization of electromagnetic waves. Rain events were also observed for intensity and duration. A prediction method which gives attenuation statistics for radio links above 10 GHz from precipitation measurements was developed. The statistical nature, in time and space, of precipitation appearance in the troposphere is shown. The cause of the deviation of measured cumulative distributions from lognormal behavior is discussed and interpreted. Relevant experimental results support a model which forecasts with good reliability cumulative attenuation statistics from measured cumulative precipitation statistics. Author (ESA)

N81-17345# Graz Univ. (Austria). Inst. fuer Nachrictentechnik und Wellenausbreitung.
ON VLF WAVE PROPAGATION IN A PLANAR ANISOTROPIC WAVEGUIDE MODEL [VLF-WELLENAUSBREITUNG IN EINEM EBENEN ANISOTROPEN WELLENLEITERMODELL]
E. Floery Oct. 1979 99 p refs In GERMAN; ENGLISH summary
(INW-7909) Avail: NTIS HC A05/MF A01

Wave propagation of long electromagnetic waves is described using an Earth-ionosphere waveguide model. A conductivity approximation is introduced in calculating surface conductivity for the anisotropic stratified ionosphere and the isotropic homogeneous Earth surface. The anisotropy of the ionosphere, due to the static terrestrial magnetic field, is represented in the general derivation by a dielectric tensor. With this method a multilayer problem is reduced to a one layer model with boundary conditions. The advantage of this physical approximation is that it represents the electromagnetic field of an arbitrary source array by a sum of orthogonal modes. To demonstrate numerical application of the model, calculation results for propagation modes in the frequency band 10 to 30 kHz are shown. Author (ESA)

N81-17346# Engins Matra, Velizy (France).
THEORETICAL STUDY OF THE BACKSCATTERING OF A LUMINOUS SIGNAL IN THE ATMOSPHERE [ETUDE THEORIQUE DE LA RETRODIFFUSION D'UN SIGNAL LUMINEUX DANS L'ATMOSPHERE]
M. Gatie, ed. 21 May 1979 41 p In FRENCH
(ASO-4573) Avail: NTIS HC A03/MF A01

A synthesis of theories dealing with the transmission of light through the atmosphere, particularly the notion of backscattering, is developed. A fundamental law defining absorption and diffusion of monochromatic light is given. Variations in the coefficients of absorption and of diffusion as a function of medium and wavelength are then discussed. Values for these coefficients are approximated. Atmospheric attenuation in terms of composition (clouds, mist, fog, rain) is considered. A calculation of the diffusion coefficient in a given direction, based on Mie theory, is made and the notion of visibility is presented.
Author (ESA)

N81-17347# Centre National d'Etudes Spatiales, Toulouse (France). Centre Spatiale.
THERMAL CONTROL CONSIDERATIONS IN SATELLITE ANTENNAS [REFLEXIONS SUR LE CONTROLE THERMIQUE DES GRANDES ANTENNES DES FUTURS SATELLITES]
Nicolas Fernandez 29 Jul. 1980 82 p refs In FRENCH; ENGLISH summary
(CNES-80/CT/PRT/SST/TH/222) Avail: NTIS HC A05/MF A01

A generalized, dimensional thermal analysis of antenna reflectors, specifically of the type used on telecommunication and direct television satellites, is presented. An optimal thermal configuration (coatings, insulation, etc.) for a paraboloid antenna 1 m in diameter was calculated. The drawbacks of mathematical modeling insofar as temperature field determination is concerned are pointed out. Calculation predictions are compared with space simulation test results for the MAROTS satellite antenna. Structural analysis computer programs (NASTRAN; CALMAR; PROTERM) were used to determine thermoelastic deformation for the MAROTS configuration. Results show that while these programs give only a rough representation of the point by point temperature distribution, the interface between thermal calculations and structural calculations seems sufficient for design purposes. Author (ESA)

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N81-17348* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MICROWAVE INTEGRATED CIRCUIT FOR JOSEPHSON

VOLTAGE STANDARDS Patent
Louis B. Holdeman (NAS-NRC, Washington, D.C.), Jaan Toots (NAS-NRC, Washington, D.C.), and Chu-Cheng Chang, inventors (to NASA) (NAS-NRC, Washington, D.C.) Issued 7 Oct. 1980 8 p Filed 31 Aug. 1978 Supersedes N78-32347 (16 - 23, p 3074) Sponsored by NASA
(NASA-Case-MFS-23845-1; US-Patent-4,227,096; US-Patent-Appl-SN-938298; US-Patent-Class-307-233R; US-Patent-Class-307-306; US-Patent-Class-333-204) Avail: US Patent and Trademark Office CSCL 09C

A microwave integrated circuit comprised of one or more Josephson junctions and short sections of microstrip or stripline transmission line is fabricated from thin layers of superconducting metal on a dielectric substrate. The short sections of transmission are combined to form the elements of the circuit and particularly, two microwave resonators. The Josephson junctions are located between the resonators and the impedance of the Josephson junctions forms part of the circuitry that couples the two resonators. The microwave integrated circuit has an application in Josephson voltage standards. In this application, the device is asymmetrically driven at a selected frequency (approximately equal to the resonance frequency of the resonators), and a d.c. bias is applied to the junction. By observing the current voltage characteristic of the junction, a precise voltage, proportional to the frequency of the microwave drive signal, is obtained.
Official Gazette of the U.S. Patent and Trademark Office

N81-17349* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DIGITAL NUMERICALLY CONTROLLED OSCILLATOR Patent
Alfred Cellier (TRW Systems Group, Redondo Beach, Calif.), Douglas C. Huey (TRW Systems Group, Redondo Beach, Calif.), and Lit N. Ma, inventors (to NASA) (TRW Systems Group, Redondo Beach, Calif.) Issued 23 Dec. 1980 8 p Filed 29 Dec. 1978 Supersedes N79-17138 (17 - 08, p 0977) Sponsored by NASA
(NASA-Case-MSC-16747-1; US-Patent-4,241,308; US-Patent-Appl-SN-974475; US-Patent-Class-328-55; US-Patent-Class-328-134; US-Patent-Class-328-37; US-Patent-Class-331-48) Avail: US Patent and Trademark Office CSCL 09A

The frequency and phase of an output signal from an oscillator circuit are controlled with accuracy by a digital input word. Positive and negative alterations in output frequency are both provided for by translating all values of input words so that they are positive. The oscillator reference frequency is corrected only in one direction, by adding phase to the output frequency of the oscillator. The input control word is translated to a single algebraic sign and the digital 1 is added thereto. The translated input control word is then accumulated. A reference clock signal having a frequency at an integer multiple of the desired frequency of the output signal is generated. The accumulated control word is then compared with a threshold level. The output signal is adjusted in a single direction by dividing the frequency of the reference clock signal by a first integer or by an integer different from the first integer.
Official Gazette of the U.S. Patent and Trademark Office

N81-17350# Royal Aircraft Establishment, Farnborough (England).
DISPLACEMENT OF CURRENT IN THE BARS OF A CAGE OF AN INDUCTION MOTOR
A. Glowacki Aug. 1980 20 p refs Transl. into ENGLISH from Przegl. Elektrotechniczny R. Liz. Z., (Czechoslovakia), v. 54, no. 4, 1978 p 157-161
(RAE-LIB-Trans-2051) Avail: NTIS HC A02/MF A01

Three methods for the calculation of the impedance of skin effect bars of cage type induction machines are discussed. The methods include the use of the effective penetration depth method, the use of a transmission line comprising a series of elemental networks as a model of the bar, and representing the bar as a network comprising a few sections, each section being related to a discreet portion of the bar. M.G.

N81-17351*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
THE 2.2 GHz SURFACE ACOUSTIC WAVE (SAW) OSCILLATOR DEVELOPMENT KU-BAND FREQUENCY SOURCE DEVELOPMENT Final Report
Feb. 1979 65 p
(Contract NAS5-23822)
(NASA-CR-160080) Avail: NTIS HC A04/MF A01 CSCL 09A

Two 2.2 GHz SAW oscillators using aluminum nitride on sapphire (AlN/Al2O3) delay lines were fabricated. The oscillators were electronically temperature compensated and characterized. One of the oscillators was used as the frequency reference for the Ku band source; the second oscillator is available for continued evaluation. A 15 GHz frequency source was designed and fabricated. The 15 GHz source consists of a Ku band FET oscillator which is phase locked to the frequency multiplied (X7) output of the 2.2 GHz SAW reference source. The Ku band source was built using microstrip circuit designs, which are hybrid compatible. Two wafer runs of 2.2 GHz TED devices were fabricated and evaluated. The devices were mounted on microstrip test substrates and evaluated as 15 GHz divide by 7 circuits. The device evaluation indicated that in their present form the TED is not a practical circuit element. Author

N81-17352# Engins Matra, Velizy (France). Div. Espace.
NEW BIPOLAR LOGIC TECHNOLOGY. PRELIMINARY STUDY [LES NOUVELLES TECHNOLOGIES BIPOLARIES LOGIQUES. PRE-EVALUATION]
E. Rabeyrjn, ed. 3 Jul. 1980 11 p In FRENCH
(DX-70/0.294) Avail: NTIS HC A02/MF A01

Results of an electrical characterization of two models of the dual D type flip-flop are presented. The models evaluated were Texas Ins. 74 ALS 74 and Fairchild 74 F 74. The performance of the two models are compared. Transl. by E.A.K.

N81-17353# General Electric Co., Syracuse, N.Y. Military Electronic Systems Operation.
RESIDUAL SIGNAL ANALYSIS: A SEARCH AND DESTROY APPROACH TO SPECTRAL ANALYSIS
John P. Costas Oct. 1980 37 p refs
(AD-A092968; R-80EMH8) Avail: NTIS HC A03/MF A01 CSCL 17/7

A signal processing procedure especially suited for use in narrowband spectral analysis or 'line tracking' applications is presented. A modular approach is used which permits each tracker to optimize estimation parameters for the line assigned. The signal estimate from each module is used to cancel the corresponding signal from the common bus to which all tracker inputs are connected. A feedback arrangement around each module restores full level to each tracker of its own assigned input signal. Each signal being tracked is thus prevented from causing interference to any other tracker. The advantages that are obtained from this arrangement are demonstrated and discussed. GRA

N81-17354# Honeywell Systems and Research Center, Minneapolis, Minn.
CCD APPLICATIONS STUDY Interim Report, 21 Sep. 1979 - 21 Apr. 1980
D. R. Lamb, J. D. Joseph, P. C. T. Roberts, and R. C. Reitan Nov. 1980 51 p refs
(Contract F19628-79-C-0176; AF Proj. 2305)
(AD-A092972; HONEYWELL-80SRC32; RADC-TR-80-309) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report discusses the design and modeling of CCD split-gate filter structures, both surface-channel and buried-channel. It also includes initial design of recursive filter structures which can be implemented without the use of op amps in either CCD or switched-capacitor form. GRA

N81-17355# Northrop Corp., Rolling Meadows, Ill. Defense Systems Div.
NOISE STUDIES ON INJECTED-BEAM CROSSED-FIELD DEVICES Final Technical Report, 1 Jul. 1979 - 30 Jun. 1980
G. Dohler and R. R. Moats Nov. 1980 60 p refs
(Contracts F49620-79-C-0220; F33615-79-C-1806; AF Proj. 2305)

(AD-A093298; DSD-094-009652; AFOSR-80-1320TR) Avail: NTIS HC A04/MF A01 CSCL 09/1

The purpose of the work reported here was to investigate experimentally noise and instabilities in crossed-field electron guns and to correlate noise measurements with beam configurations as measured in the beam analyzer developed by Northrop with Air Force support. The beam tester measures beam location by collisions which take place between the electron beam and a helium molecular beam injected at right angles to the electron beam. GRA

N81-17356# Naval Research Lab., Washington, D. C.
POWER LIMITS IN CYLINDRICAL GYROMONOTRONS USING TEon1 MODES
M. E. Read, K. R. Chu, and K. J. Kim 13 Nov. 1980 26 p refs
(Contract DE-AC01-79ET-52053)
(AD-A092955; NRL-MR-4349) Avail: NTIS HC A03/MF A01 CSCL 09/1

Gyrotron oscillators (gyromonotrons) are of great interest as sources of high power mm-wave radiation for heating and preionization in fusion devices. The total radiation power required for reactor size devices has been estimated at 50 - 100 MW at approx. 150 GHz, far beyond the present state of the art for a single source. Since the feasibility and cost of a heating system may be strongly dependent on the number of devices required, it is of interest to estimate the upper limit of the output power of a single gyromonotron. In this note, we present calculations for such an estimate. In addition, we determine the lower limit on output powers. The detailed calculations are limited to right circular cavities supporting TEon1 modes, but some of the results are directly applicable to other geometries. All calculations are for devices operating near the cyclotron frequency, with a beam energy of 70 keV and negligible velocity spread. GRA

N81-17357# Naval Postgraduate School, Monterey, Calif.
ADVANCED SIMULATION OF DIGITAL FILTERS M.S. Thesis
Gerald S. Doyle Sep. 1980 308 p refs
(AD-A093252) Avail: NTIS HC A14/MF A01 CSCL 09/3

An Advanced Simulation of Digital Filters has been implemented on the IBM 360/67 computer utilizing Tektronix hardware and software. The program package is appropriate for use by persons beginning their study of digital signal processing or for filter analysis. The ASDF programs provide the user with an interactive method by which filter pole and zero locations can be manipulated. Graphical output on both the Tektronix graphics screen and the Versatec plotter are provided to observe the effects of pole-zero movement. GRA

N81-17358# RCA Labs., Princeton, N. J. Microwave Technology Center.
HIGH-ENERGY ION IMPLANTATION FOR MULTIGIGABIT RATE GaAs INTEGRATED CIRCUIT Annual Report, 15 May 1979 - 30 Jun. 1980
S. G. Liu, C. P. Wu, and C. W. Magee Oct. 1980 66 p refs
(Contract N00014-78-C-0367; RF54582001; NR Proj. 383-046)
(AD-A093103; PRRL-80-CR-37) Avail: NTIS HC A04/MF A01 CSCL 07/4

The objectives of this program are: (1) study of high-energy ion implantation of donors into GaAs for multigigabit-rate GaAs integrated-circuit development; and (2) annealing of implanted GaAs using high-power lasers to remove lattice damage and activate implanted donors. We have: (1) investigated implantation of Si(28-) into semi-insulating GaAs with implant energies ranging from 40 keV to 1.2 MeV; (2) developed a capless thermal annealing process under arsenic overpressure which results in high activation efficiency with excellent surface morphology; (3) investigated laser-annealing of Si-implanted GaAs using a high-power Nd:Glass laser and a ruby laser. Electrical activation of high-dose, low-energy (-300 keV) implanted samples is many times higher in laser-annealed samples than for those thermally annealed; (4) demonstrated nonalloyed ohmic contacts formed by direct evaporation of AuGe onto high-dose implanted laser-irradiated GaAs surface; and (5) studied impurity distribution in as-implanted, thermally annealed, and laser-annealed samples by secondary ion mass spectrometry. GRA

N81-17359# Varian Associates, Palo Alto, Calif.
HIGH POWER KLYSTRONS FOR EFFICIENT RELIABLE HIGH POWER AMPLIFIERS Final Technical Report, 16 Jun. 1976 - 31 Jul. 1979
M. Levin Nov. 1980 163 p
(Contract DAAB07-76-C-8072; DA Proj. 17-63707-D-245)
(AD-A092903; CSA-76-8072-F) Avail: NTIS HC A08/MF A01 CSCL 09/1

This report covers the design of reliable high efficiency, high power klystrons which may be used in both existing and proposed troposcatter radio systems. High Power (10 kW) klystron designs were generated in C-band (4.4 GHz to 5.0 GHz), S-band (2.5 GHz to 2.7 GHz), and L-band or UHF frequencies (755 MHz to 985 MHz). The tubes were designed for power supply compatibility and use with a vapor/liquid phase heat exchanger. Four (4) S-band tubes were developed in the course of this program along with two (2) matching focusing solenoids and two (2) heat exchangers. These tubes use five (5) tuners with counters which are attached to the focusing solenoids. A reliability mathematical model of the tube and heat exchanger system was also generated. GRA

N81-17360# Varian Associates, Palo Alto, Calif. Solid State Lab.
RESEARCH ON InGaAs FETS Interim Technical Report, Sep. 1979 - Sep. 1980
S. Bandy, S. Hyder, C. Nishimoto, and C. Hooper Sep. 1980 83 p refs
(Contract N00014-78-C-0380; RF54581001; NR Proj. 251-030)
(AD-A092941; ITR-2) Avail: NTIS HC A05/MF A01 CSCL 09/1

The fabrication of Schottky-gate field-effect transistors on InGaAs lattice matched to InP is reported. A higher bandgap interface layer is used to lower the gate leakage to acceptable levels. A technique to deduce the effective saturated electron drift velocity is given which shows over a factor of two higher saturated velocity for InGaAs in comparison to GaAs. GRA

N81-17361# General Dynamics Corp., Pomona, Calif. Advanced Manufacturing Technology Lab.
MANUFACTURING TECHNOLOGY PROGRAM FOR MICROWAVE COMPONENTS Final Report, Mar. 1979 - Feb. 1980
William L. Macturk 28 Apr. 1980 461 p
(Contract N66001-79-C-0022)
(AD-A093446; NAVSEA-MT-S-617-78; NOSC/TR-560) Avail: NTIS HC A20/MF A01 CSCL 13/8

The work contained in this report details the activities accomplished from March 1979 to the end of February 1980 by the Advanced Manufacturing Technology Section at General Dynamics, Pomona Division, on a Manufacturing Technology Program for Microwave Components. Specifically, this program deals with the injection molding and plating of a plastic microwave waveguide post filter operating in the S band region and suitable for use on the Navy Phalanx Ship/Gun System now under production at General Dynamics Pomona. GRA

N81-17362# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
MANUFACTURING METHODS AND TECHNOLOGY FOR DIGITAL FAULT ISOLATION OF PRINTED CIRCUIT BOARDS Final Report, Sep. 1979 - Oct. 1980
15 Nov. 1980 73 p
(Contract DAAK40-78-C-0290)
(AD-A093797; HAC-FR-80-12-975) Avail: NTIS HC A04/MF A01 CSCL 14/2

This report presents the final recommendations and conclusions, with supporting data, resulting from the contract option phase of contract DAAK40-78-C-0290. It describes the manufacturing technology and test system that will enable detection, identification, and location of digital faults in the advanced missile electronic systems that will be used in the 1980's. Emphasis is placed on the fault diagnosis of large printed circuit boards containing complex hybrid digital microelectronic

circuits. The basic effort included an industry survey for digital printed circuit board test requirements and available test system capabilities, the D/PCB testability investigation and resulting design guide, the development of digital fault isolation methodology and the comprehensive selection of the optimum ATE that recommended the DTS-70 system. The contract option phase of this project involved the purchase and installation of the DTS-70 system, the selection of the PN-1635972 and the PN-1646178 D/PCBs for testing, the development of generalized test software and the development of the specific hardware and software needed to test these worst-case boards. GRA

N81-17363# Texas Instruments, Inc., Dallas. Semiconductor Group.

ELECTROMIGRATION TESTING OF Al ALLOY FILMS Final Technical Report, 25 Sep. 1978 - 30 Jun. 1980

P. B. Ghate Griffiss AFB, N.Y. RADC Oct. 1980 86 p refs
(Contract F30602-78-C-0186; AF Proj. 2338)
(AD-A093492; TI-03-80-29; RADC-TR-80-328) Avail: NTIS HC A05/MF A01 CSCL 09/1

A search for reliability improvement of Al film interconnections has led to the introduction of Al-Alloy films such as Al-Cu, Al-Cu-Si and so on. This report describes the results of an in-depth study of Al, Al-Cu (2 wt % Cu) and Al-Cu-Si (2 wt % Cu - 1% Si) film interconnections and Silicon/Al-Alloy film contacts as they impact reliability of integrated circuits. Resistivity, microstructure and composition of Al-Alloy films vacuum deposited from an induction heated source (IN-Source) and dc magnetron sputter deposition techniques have been investigated and it is concluded that IN-Source and dc magnetron sputter deposition techniques are equally capable of producing Al, Al-Cu (2 wt %) and Al-Cu-Si (2 wt % Cu - 1% Si) films of comparable compositions, resistivity and microstructure. Chemical analysis X-ray fluorescence electron microprobe, scanning and transmission electron microscopy and ion microprobe have been employed for Al-Alloy film characterization. Availability of automated dc magnetron sputter (M-S) deposition equipment was a primary factor in the selection of magnetron sputter deposited Al-Alloy films for electromigration testing. GRA

N81-17364# Westinghouse Electric Corp., Baltimore, Md. Microwave Circuit Development.

S-BAND SOLID STATE TRANSMITTER

Feb. 1980 20 p ref
(Contract DAAG39-78-C-0148)
(AD-A093656) Avail: NTIS HC A02/MF A01 CSCL 09/5

Solid-state power generation techniques are presently available which allow for the generation of high peak power in the S-band frequency domain. Transmitters so configured would have inherent advantages of ruggedness, improved reliability, simpler modulation, and total use of low voltage supplies which would make it an excellent replacement for thermionic transmitters presently used. GRA

N81-17365# Naval Research Lab., Washington, D. C.

RECOVERY CHARACTERISTICS OF EXPLODING WIRE FUSES IN AIR AND VACUUM Interim Report

I. M. Vitkovitsky and V. E. Scherrer 26 Dec. 1980 16 p refs Sponsored by Navy
(AD-A093681; NRL-MR-4416) Avail: NTIS HC A02/MF A01 CSCL 19/1

The dielectric strength of exploded wire fuses during the vaporization and after recovery period and the resistivity of the opening fuses are functions of time and depend on the medium surrounding the fuse channel. These parameters determine the efficiency of power flow from the storage system to the load. Specifically, design of experiments using loads with variable impedance, such as imploding plasmas, require detailed information on the fuse characteristics during the time when the load impedance is changing. To provide data that determines the interaction between fuses and variable impedance loads, inductive and recovery electric fields and fuse resistance in air and vacuum were studied. The results show the inductive field amplitude follows the dependence on vaporization time similar to that established for other media and for longer vaporization times. The characteristics of recovery rate of fuses in air and vacuum differ drastically due to the early onset of ionization in fuse channels in vacuum. GRA

N81-17366# Pattern Analysis and Recognition Corp., Rome, N. Y.

SPECTRAL PROCESSING ANALYSIS SYSTEMS (SPANS) Final Technical Report, Nov. 1978 - Jul. 1980

Robert E. Bozek Nov. 1980 53 p refs
(Contract F30602-79-C-0034; AF Proj. R135)
(AD-A093497; PAR-80-48; RADC-TR-80-335) Avail: NTIS HC A04/MF A01 CSCL 09/3

This effort designed and developed a real-time on-line signal processing and analysis program. Capabilities include off-line/on-line signal processing to 100 KHz, time and frequency domain transformations, high speed and high resolution refresh graphics. This report is an introduction to the system's hardware and software capabilities. GRA

N81-17367# Hughes Aircraft Co., Culver City, Calif. Microelectronic Products Dept.

HYBRID MICROCIRCUIT REWORK PROCEDURES EVALUATION Final Technical Report, 21 Sep. 1978 - 21 Sep. 1979

G. T. Malloy Griffiss AFB, N.Y. RADC Aug. 1980 168 p refs
(Contract F30602-78-C-0310; AF Proj. 2338)
(AD-A092950; HAC-FR-79-76-1131; RADC-TR-80-283) Avail: NTIS HC A08/MF A01 CSCL 09/5

The objective of this program is to make a comprehensive assessment of all factors related to the rework of hybrid microcircuits and how these factors affect hybrid reliability. Based on this assessment, rework, criteria and guidelines have been prepared for inclusion in MIL-M-38510. The program effort consisted of two major tasks: (1) A review of the hybrid microcircuit literature and a survey of 21 manufacturers of military grade hybrids, to determine the common practices and in-process controls used and problems encountered in hybrid manufacturing. (2) An experimental evaluation of the reliability of reworked vs non-reworked test specimen hybrids. The test phase of the program utilized the effects of mechanical and thermal stresses, applied as conventional MIL-STD-883 environmental test exposure, to measure the effects of one, two or more rework cycles on wire bond degradation or failure. GRA

N81-17368# Naval Research Lab., Washington, D. C.

ON A WIDE-BAND FAST WAVE GYROTRON TRAVELING WAVE AMPLIFIER

Y. Y. Lau and K. R. Chu 10 Dec. 1980 20 p refs
(XF62581007; RR0110941)
(AD-A093152; NRL-MR-4346) Avail: NTIS HC A02/MF A01 CSCL 09/1

A simple scheme is proposed for the construction of a wide-band fast wave gyrotron travelling wave amplifier. The key features of this scheme include a contoured waveguide, a tapered magnetic field, and injection of input signals in opposite direction of the streaming electrons. Bandwidths at tens of percents, and gain at tens of decibels, are projected. GRA

N81-17369# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.

SWITCHING MODE POWER SUPPLIES M.S. Thesis

David W. Beard Sep. 1980 95 p refs
(AD-A093246) Avail: NTIS HC A05/MF A01 CSCL 10/2

The subject of switching mode power supplies was examined. A comparison between linear regulators and switchng mode power supplies was made to show the options available for the various types of convertors. Two switching mode power supplies were constructed and tested. The operating efficiency of both systems was found to be more than eighty percent over the specified input voltage and load current conditions. The switching mode power supply circuits required additional components in the design due to the complex pulse width regulation, pulse amplification, and self start circuit required for the system operation. The switching mode power supply is an inherent source of radio frequency interference, thus the complexity of the problem was examined with several methods presented that minimized the RFI of the system. GRA

N81-17370# Hughes Aircraft Co., Culver City, Calif.

EVALUATION OF ELECTRICAL TEST CONDITIONS IN MIL-M-38510 SLASH SHEETS Final Technical Report, Aug.

1978 - Sep. 1979
K. Sandgren Aug. 1980 111 p
(Contract F30602-78-C-0193; AF Proj. 2338)
(AD-A093215; HAC-FR-80-76-706; RADC-TR-80-263) Avail: NTIS HC A06/MF A01 CSCL 14/2

Adequacy of MIL-M-38510 slash sheet requirements for electrical test conditions in an automated test environment were evaluated. Military temperature range commercial devices of 13 types from 6 manufacturers were purchased. Software for testing these devices and for varying the test conditions was written for the Tektronix S-3260 test system. The devices were tested to evaluate the effects of pin-condition settling time, measurement sequence of the same and different D-C parameters, temperature sequence, differently defined temperature ambients, variable measurement conditions, sequence of time measurements, pin-application sequence, and undesignated pin condition ambiguity. An alternative to current tri-state enable and disable time measurements is proposed; S-3260 'open' and 'ground' conditions are characterized; and suggestions for changes in MIL-M-38510 slash sheet specifications and MIL-STD-883 test methods are proposed, both to correct errors and ambiguities and to facilitate the gathering of repeatable data on automated test equipment. Data obtained showed no sensitivity to measurement or temperature sequence nor to temperature ambient, provided that test times were not excessive. V sub ICP tests and some low current measurements required allowance for a pin condition settling time because of the test system speed. Some pin condition application sequences yielded incorrect measurements. Undefined terminal conditions of output pins were found to affect I sub OS and propagation delay time measurements. Truth table test results varied with test frequency and V sub IL for low-power Schottky devices. GRA

N81-17371# Bendix Corp., Kansas City, Mo.
HERMETIC SEALING OF HYBRID MICROCIRCUITS Final Report
J. H. Williams Sep. 1980 14 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2486) Avail: NTIS HC A02/MF A01

The capability to hermetically seal hybrid microcircuits and large scale integrated circuits was established. Initial production results indicate a yield of 75% for hybrid flatpacks and 95% for integrated circuit packages. Future efforts will include particle impact noise detection testing of sealed packages and the development of a rework capability for hermetically sealed packages that must be opened, repaired, and resealed. DOE

N81-17372# Sandia Labs., Albuquerque, N. Mex.
VOLTAGE-CLEARANCE RECOMMENDATIONS FOR PRINTED BOARDS
C. W. Jennings, Gerald Cave (Delsen Testing Lab., Glendale, Calif.), Al Evans (Rockwell Intern., Cedar Rapids, Iowa), D. J. Harrington (Bell Lab., Richmond, Va.), J. Kirchenbaum (Trace Lab., Canoga Park, Calif.), Richard L. Martz (Naval Avionics Center, Indianapolis), R. C. Mierendorf (Square D Co., Milwaukee), and George A. Smith (Trace Lab., Baltimore) 1980 25 p refs Presented at the Fall 1980 IPC Meeting on Elect. Clearance, Chicago, 28 Sep. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-2065C; CONF-800991-1) Avail: NTIS HC A02/MF A01

Present and future trends in printed board designs point to higher circuit densities with narrower lines and closer spacings. The reduction of nominal spacing between conductive elements raises questions concerning the adequacy of present voltage clearance recommendations. The present recommendations are considered too conservative in that they are weighted with large safety factors, especially for small clearance, and are frequently disregarded by many designers. Published voltage breakdown measurements made on printed boards with comb patterns with their enhanced conductor test lengths show breakdown occurring at much higher voltages than those specified for the clearances in existing documents. Published breakdown measurements were reviewed and additional measurements necessary to provide voltage clearance recommendations were made. DOE

N81-17373# Battelle Pacific Northwest Labs., Richland, Wash.
DESIGN AND PERFORMANCE OF A 100-kg/h, DIRECT CALCINE-FED ELECTRIC-MELTER SYSTEM FOR NUCLEAR-WASTE VITRIFICATION
R. D. Dierks Nov. 1980 70 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3387) Avail: NTIS HC A04/MF A01

Physical characteristics of a ceramic-lined, joule-heated glass melter that is directly connected to the discharge of a spray calciner are described. The vitrification of simulated nuclear-waste slurries is discussed as well. Melter performance characteristics and subsequent design improvements are described. The melter was maintained at operating temperature (900 to 1260 C) for 15 months, and produced 62,000 kg of glass. The maximum sustained operating period was 122 h, during which glass was produced at the rate of 70 kg/h. DOE

N81-17374# Engins Matra, Velizy (France).
CHARACTERISTICS OF SOME NUMERICAL FILTERS [CARACTERISTIQUES DE QUELQUES FILTRES NUMERIQUES]
J. M. Debarre, ed. 23 Jun. 1978 75 p In FRENCH; ENGLISH summary
(GA-267) Avail: NTIS HC A04/MF A01

Numerical filters obtained from known analog filters by the Z bilinear transformation, by a modified Z bilinear transformation, or by a method of decomposition into simple elements are reviewed. Emphasis is on the behavior of these filters in response to step-changes in position, speed, and in acceleration. Concerning Wiener filters, coefficients are optimized in function of the variance in measurement noise and of the variance in system noise. Gain and phase curves are calculated as a function of frequency for different valves of (T/tau) with T the sampling period and tau a defined time constant. Author (ESA)

N81-17375# Centre National d'Etudes Spatiales, Toulouse (France).
RULES FOR EVALUATION, SCREENING, AND QUALIFICATION OF HYBRID CIRCUITS [REGLES D'EVALUATION, DE DEVERMINAGE ET DE QUALIFICATION DES CIRCUITS HYBRIDES]
M. Billot 9 May 1979 24 p In FRENCH; ENGLISH summary
(CNES-CT/PRT/QPE/FT/103) Avail: NTIS HC A02/MF A01

Hybrid circuit design, fabrication, and checkout criteria are listed. The evaluation philosophy governing the SPOT project and the acceptability of hybrid microcircuit manufacturing practices is explained. The inspection and procurement rules for added-on microcomponents as well as the screening and lot qualification rules for hybrid microcircuits are given. These criteria are applicable to every type of hybrid circuit (thick or thin film). Author (ESA)

N81-17376# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Thermique.
APPLICATION OF THERMOELECTRIC COOLING THEORY TO THE CHARACTERIZATION OF PELTIER EFFECT THERMAL ELEMENTS [APPLICATION DE LA THEORIE DU REFROIDISSEMENT THERMOELECTRIQUE A LA CARACTERISATION DES THERMOS ELEMENTS A EFFET PELTIER (TEP)]
N. Fernandez 10 Apr. 1980 27 p In FRENCH; ENGLISH summary
(CNES-CT/PRT/SST/TH/119) Avail: NTIS HC A03/MF A01

A synthesis of the theory of thermoelectric cooling is applied to the practical as well as numerical characterization of cooling systems that work by the Peltier effect. A computerized calculation procedure for determining the coefficient of performance of a Peltier module, given its Seebeck coefficient, its conductivity, its resistance, and its J coefficient of merit, is outlined. An example of application is drawn from the design analysis of a SPACELAB experiment package. Calculation results are in good agreement with test results. Author (ESA)

N81-17377# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Fiabilite-Technologie.
ON THE USE OF OPTOELECTRONIC COMPONENTS IN SATELLITES WITH LONG LIFETIMES [UTILISATION DES COMPOSANTS OPTOELECTRONIQUES DANS LES SATELITES A LONGUE DUREE DE VIE]
B. Cluzel 23 Apr. 1980 16 p refs In FRENCH; ENGLISH summary

(CNES-80/QPE/FT/106) Avail: NTIS HC A02/MF A01

Different optocoupler failure modes, related to type of junction diode, packaging, and method of optical coupling, are examined. A correlation between fabrication technology and degradation rate is shown. Degradation due to extended space environment exposure, i.e., cumulative radiation damage, is also considered. Results are generalized to all optoelectronic components and a mathematical model which gives the degradation curve as a function of time and current is proposed.

Author (ESA)

N81-17378# Centre National d'Etudes Spatiales, Toulouse (France). Dept. Thermique.

CHARACTERIZATION OF A THERMAL ELEMENT. APPLICATION TO THE COOLING OF A PHOTOMULTIPLIER. SPACELAB EXPERIMENT ESO 16 Final Report [CARACTERISATION D'UN THERMO-ELEMENT. APPLICATION AU REFROIDISSEMEN D'UN PHOTOMULTIPLICATEUR. EXPERIENCE ESO 16 SPACELAB 81]

J. L. Monnac (Inst. National des Sciences Appliquees, Toulouse) and E. Maggi (Inst. National des Sciences Appliquees, Toulouse) Jun. 1979 82 p refs In FRENCH; ENGLISH summary

Avail: NTIS HC A05/MF A01

The cooling of a photomultiplier, using a cooling element which works by the Peltier effect, is considered. The theoretical physics of thermoelectric cooling are briefly reviewed. Theory is applied to the characterization of the thermal element COGIE FC 1,4-71-10. A coefficient of performanc was assigned and the advantages of this cooling method are enumerated. Application of this cooling element in the experiment package ESO16 was undertaken. However, thermal test rig results are reported as unsatisfactory. Further testing is necessary to determine the cause.

Author (ESA)

N81-17379# National Bureau of Standards, Washington, D.C. Center for Fire Research.

MODELING FOR DETERMINATION OF TEMPERATURES OF ELECTRICAL CABLES WITHIN THERMALLY INSULATED WALLS Interim Report

David D. Evans Oct. 1980 30 p refs Sponsored in part by DOE

(PB81-113847; NBSIR-80-2129) Avail: NTIS HC A03/MF A01 CSCL 09A

Models are developed to predict the temperature rise caused by resistive heating of a current carrying electric cable within an insulated wall cavity, with emphasis on simplified models to minimize computation time. Predictions are compared to measurements performed on an AWG-12 2 G NM cable installed in a laboratory wall space mock-up. Results of the two dimensional model are within 15 percent of the measured temperatures. The heat sink effect of the wood studs within the wall on the temperature rise of the section of cable passing through them is demonstrated both with experiment and calculation. GRA

N81-17380# *National Bureau of Standards, Washington, D.C.* Center for Absolute Physical Quantities.

AN ANALYSIS OF THE EFFECTS DYNAMICS AND STATIC *FORCES PRESENT IN THE NBS SI VOLT EXPERIMENT* Final Report

M. E. Cage Sep. 1980 219 p refs

(PB81-115370; NBSIR-80-2143) Avail: NTIS HC A10/MF A01 CSCL 14B

Algebraic expression for the electrical forces present on the suspended electrode of the electrometer were obtained. These forces, as well as gravitation forces, were used in the principle of virtual work and D'Alemberts principle to obtain the second order, nonlinear, inhomogeneous, coupled differential equations of motion for the balance. Exact analytical solutions were obtained using small angle approximations and perturbations methods. Estimates were then made of the uncertainties that might result in both the slope and path integral method in order to determine what requirements must be satisfied to reduce the systematic and random errors of the force determination and the capacitance measurements to acceptable levels so that the SI volt can be determined within a few ppm. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N81-17381*# Cambridge Hydrodynamics, Inc., Mass.

ADVANCED STABILITY ANALYSIS FOR LAMINAR FLOW CONTROL Final Report

Steven A. Orszag Feb. 1981 126 p refs

(Contract NAS1-15894)

(NASA-CR-165661; CHI-43) Avail: NTIS HC A07/MF A01 CSCL 20D

Five classes of problems are addressed: (1) the extension of the SALLY stability analysis code to the full eighth order compressible stability equations for three dimensional boundary layer; (2) a comparison of methods for prediction of transition using SALLY for incompressible flows; (3) a study of instability and transition in rotating disk flows in which the effects of Coriolis forces and streamline curvature are included; (4) a new linear three dimensional instability mechanism that predicts Reynolds numbers for transition to turbulence in planar shear flows in good agreement with experiment; and (5) a study of the stability of finite amplitude disturbances in axisymmetric pipe flow showing the stability of this flow to all nonlinear axisymmetric disturbances. S.F.

N81-17382*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

NUMERICAL SIMULATION OF NATURAL CONVECTION IN A SPHERICAL CONTAINER DUE TO COOLING AT THE CENTER (IDEALIZATION OF THE LaI/KROES EXPERIMENT)

S. J. Robertson Feb. 1981 20 p refs

(Contract NASw-3281)

(NASA-CR-163955; LMSC-HREC-TR-D784100) Avail: NTIS HC A02/MF A01 CSCL 20D

Natural convection in a spherical container with cooling at the center was numerically simulated using a numerical fluid dynamics computer program. The numerical analysis was simplified by assuming axisymmetric flow in the spherical container, with the symmetry axis being a sphere diagonal parallel to the gravity vector. This axisymmetric spherical geometry was intended as an idealization of the proposed LaI/Kroes crystal growing experiment to be performed on Spacelab. Results were obtained for a range of Rayleigh numbers from 25 to 10,000. The computed velocities were found to be approximately proportional to the Rayleigh number over the range of Rayleigh numbers investigated. S.F.

N81-17383*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AN EXTENDED CLASSICAL SOLUTION OF THE DROPLET GROWTH PROBLEM

B. Jeffrey Anderson, John Hallett (Desert Research Inst. Reno), *and Maurice Beesley (Nevada Univ. System, Reno) Jan. 1981* 49 p refs

(NASA-TM-82392) Avail: NTIS HC A03/MF A01 CSCL 20D

Problems of applying the classical kinetic theory to the growth of small droplets from vapor are examined. A solution for the droplet growth equation is derived which is based on the assumption of a diffusive field extending to the drop surface. The method accounts for partial thermal and mass accommodation at the interface and the kinetic limit to the mass and heat fluxes, and it avoids introducing the artifact of a discontinuity in the thermal and vapor field near the droplet. Consideration of the environmental fields in spherical geometry utilizing directional fluxes yields boundary values in terms of known parameters and a new Laplace transform integral. *Author*

N81-17384*# Connecticut Univ., Storrs. Dept. of Mechanical *Engineering.*

TURBINE ENDWALL TWO-CYLINDER PROGRAM Semiannual Status Report, 1 Jul. 1980 - 1 Jan. 1981

Lee S. Langston 1981 38 p refs
(Grant NsG-3238)
(NASA-CR-163950) Avail: NTIS HC A03/MF A01 CSCL 20D

A series of experiments to study the three dimensional separation of fluid flow around two isolated cylinders mounted on an endwall are described. Topics covered include: (1) water tunnel testing for both the single and double cylinder cases; (2) wind tunnel flow characteristics; (3) static pressure distribution measured on the cylinders; and (4) design and construction of a pressure reference system. S.F.

N81-17385# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.

AN ALGORITHM FOR LANGUAGE-INDEPENDENT TRANSFER HYDROGRAPHIC INFORMATION

William G. Moir 1980 30 p refs
(AD-A093437) Avail: NTIS HC A03/MF A01 CSCL 05/3

A method of communication of hydrographic information is presented. Based on the DMAHTC Chart No. 1, a controlled vocabulary is used to create an algorithm by which information can be transferred in a language-independent, computer-compatible code. Using a specific nautical chart, a controlled vocabulary and this coding algorithm as parameters, a method is presented by which all members of the hydrographic community can share vital information such as Notice to Mariners, in a common format without the limitations imposed by a multiplicity of languages and chart formats. GRA

N81-17386# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.

SEPARATED FLOW AND BOUNDARY LAYER RESEARCH ***Final Report, 26 Apr. 1975 - 31 Jul. 1980***

Seymour M. Bogdonoff and Gary S. Settles Oct. 1980 59 p refs
(Contract 44620-75-C-0080; AF Proj. 2307)
(AD-A093054; MAE-1494; AFOSR-80-1252TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

The two dimensional corner study provides a unique framework bridging attached to separated flows. It only needs the measurements of local heat transfer and flowfield fluctuating measurements to be a complete description of an important shock wave boundary layer configuration. The study of a two dimensional *reattaching free shear layer has provided a unique* series of measurements, including the first turbulence data, at one flow condition and geometry. Reynolds number and geometry *effects have yet to be studied, but the physics of reattachment* have been explored in a way not heretofore examined. The investigation of three dimensional shock wave turbulent boundary *layer interactions, specifically of the swept wedge, provides new* insights into these complex flows with strong lateral gradients. The studies have revealed many new elements, but 'separation' *and 'reattachment' take on new meanings which have yet to be* clarified. Hypersonic turbulent boundary layers have been found to have very complex structures with very wide density variations and orders of magnitude unit Reynolds number changes across the layers. Highly viscous, laminar sublayers, are bounded by *turbulent layers in which fluctuations of 50% are* experienced. Many of the results of the present studies were used to test, validate, and guide major efforts in computational *fluid dynamics. To date, the computations adequately describe* attached flows, but do not capture the details of separated flows, although general characteristics of the flow field are *predicted. The results of computations, sensitivity analysis, and* testing of various models (turbulence) were important guides for the experimental studies. GRA

N81-17387# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.

CURRENT PROBLEMS IN TURBOMACHINERY FLUID DYNAMICS Interim Report, 1 Jun. 1979 - 30 Sep. 1980

Edward M. Greitzer, William T. Thompkins, Jr., James E. McCune, Alan H. Epstein, Choon S. Tan, Jack L. Kerrebrock, and William R. Hawthorne 26 Nov. 1980 104 p refs
(Contract F49620-78-C-0084; AF Proj. 2307)
(AD-A093375; AFOSR-80-1355TR) Avail: NTIS HC A06/MF A01 CSCL 20/4

A multi-investigator effort on problems of current interest in turbomachinery fluid dynamics is being carried out in the Gas Turbine and Plasma Dynamics Laboratory of MIT. Within the overall program four different tasks having to do with a wide range of design and off-design flow fields have been identified. These are: (1) investigation of fan and compressor design point fluid dynamics (including formulation of design procedures using current three dimensional transonic codes and development of techniques for instantaneous measurements in transonic fans); (2) studies of compressor stability enhancement (including basic investigations of the fluid dynamics of rotor casing treatment); (3) fluid mechanics of gas turbine engine operation in inlet flow distortion (including inlet vortex distortion); and (4) investigations of three dimensional flows in highly loaded turbomachines (including actuator duct theory and blade-to-blade flow analysis) and linearized analysis of swirling three dimensional flows in turbomachines. This interim report summarizes progress made to date as well as indicates the direction of future efforts on the various tasks. GRA

N81-17388# Mississippi State Univ., Mississippi State. Engineering and Industrial Research Station.

A METHOD FOR THE GENERATION OF GENERAL THREE-DIMENSIONAL COORDINATES BETWEEN BODIES OF ARBITRARY SHAPES Interim Report

Z. U. A. Warsi Oct. 1980 26 p refs
(Grant AF-AFOSR-0185-80; AF Proj. 2304)
(AD-A093420; MSSU-EIRS-ASE-80-7; AASE-80-2; AFOSR-80-1340TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Analytical development of a set of second order elliptic partial differential equations for the generation of three dimensional curvilinear coordinates between two arbitrary shaped bodies is presented. *The resulting equations have only two independent* variables and therefore require an order of magnitude less working core capacity than when equations depending on all three *independent variables are considered. The method also allows,* in a straightforward manner the possibility of coordinate contraction in the desired regions. GRA

N81-17389# Scientific Research Associates, Inc., Glastonbury, Conn.

COMPUTATION OF LAMINAR AND TURBULENT FLOW IN CURVED DUCTS, CHANNELS, AND PIPES USING THE *NAVIER-STOKES EQUATIONS* ***Final Report, 1 Oct. 1979 - 30 Sep. 1980***

R. C. Buggeln, W. R. Briley, and H. McDonald Dec. 1980 42 p *refs*
(Contract N00014-79-C-0713)
(AD-A093736; SRA-R80-920006-F) Avail: NTIS HC A03/MF A01 CSCL 20/4

Both laminar and turbulent flows in strongly curved ducts, channels, and pipes are studied by *numerical methods. The study* concentrates on the curved square-duct geometry and flow conditions for which detailed measurements have been obtained *recently by Taylor, Whitelaw, and Yianneskis. The solution* methodology encompasses solution of the compressible ensemble-averaged Navier-Stokes equations at low Mach number using a *split linearized block implicit (LBI) scheme and rapid convergence* on the order of 80 noniterative time steps is obtained. The treatment of turbulent flows includes resolution of the viscous *sublayer region. A series of solutions for both laminar and turbulent* flow and for both two and three dimensional geometries of the same curvature is presented. The accuracy of these solutions is *explored by mesh refinement and by comparison with experi*ment. In summary, good qualitative and reasonable quantitative agreement between solution and experiment is obtained. *Collectively,* this sequence of results serves to clarify the physical structure of these flows and hence how grid selection procedures might be adjusted to *improve the numerical accuracy and* experimental agreement. For a three dimensional flow of considerable complexity, the relatively good agreement with *experiment obtained for the turbulent flow case despite a coarse* grid must be regarded as encouraging. GRA

N81-17390# *Stevens Inst. of Tech., Hoboken, N. J.*

A PARTIALLY CAVITATING HYDROFOIL IN A GUST Final Report, 15 Nov. 1978 - 30 Nov. 1980

A. S. Peters, Theodore R. Goodman, and John P. Breslin Nov.

1980 57 p refs
(Contract N00014-77-C-0122; RR0230101)
(AD-A093474; SIT-DL-80-2118) Avail: NTIS HC A04/MF A01 CSCL 20/4

An analysis is made of a hydrofoil with partial cavitation in a traveling gust. The problem is formulated in the time domain with pressure (acceleration potential) as the fundamental dependent variable. It is shown that, in the limit, as the aspect ratio of the foil becomes large, the second time derivative of the cross-sectional area of the cavity vanishes regardless of the shape of the gust. Integral equations are presented through which the length of the cavity and the unsteady pressure distribution on the foil can be determined. Since these equations are highly nonlinear and require formidable numerical procedures to solve, no attempt is made to solve them. It is shown in an appendix that the earliest possible appearance of a nonvanishing second time derivative of the cross-sectional area of the cavity is to the order of the square of the reciprocal of the aspect ratio and that to this order the pressures at distances large in comparison with the chord of the foil (but not the span) grow logarithmically. It may be inferred from this result that the pressures in the far field can be reduced by increasing the aspect ratio. GRA

N81-17391# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
AN EXPERIMENTAL STUDY OF NONSTATIONARY INSTABILITIES OF PLANAR SHOCK WAVES IN IONIZING ARGON
W. L. Buchanan Aug. 1980 92 p refs Sponsored in part by National Research Council of Canada
(Grant AF-AFOSR-3303-77)
(AD-A093413; UTIAS-TN-222; AFOSR-80-1356TR; ISSN-0082-5263) Avail: NTIS HC A05/MF A01 CSCL 20/4

A multipulse laser-Schlieren technique was used to study the time behavior of instabilities in the translational front of planar shock waves in ionizing argon in the 10 x 18 cm hypervelocity shock tube at UTIAS. Using a ruby laser in a combined normal-lasing/giant-pulse mode, at least two monochromatic light pulses were obtained about 7 microsec apart. As well, a schlieren system compatible with the 23 cm dia Mach-Zehnder interferometer was created with maximum sensitivity for some low-density conditions. The almost-sinusoidal perturbations were found to change with time; some like a standing wave, and others like a travelling wave. It was not, however, possible to associate the observed perturbations with either form of wave motion in nearly half of the cases. A simple graph provides a way to predict the shape of the perturbations from the shock-wave parameters. GRA

N81-17392# Naval Research Lab., Washington, D. C.
APPROXIMATE EQUATIONS FOR TRANSPORT COEFFICIENTS OF MULTICOMPONENT MIXTURES OF NEUTRAL GASES
J. Michael Picone and Elaine S. Oran 19 Nov. 1980 87 p refs
(RR0240241)
(AD-A093145; NRL-MR-4384) Avail: NTIS HC A05/MF A01 CSCL 20/13

Reactive flow systems often consist of multicomponent mixtures of neutral gases. Accurate modelling of reactive flows will, in many cases, require the accurate representation of transport phenomena in the conservation equations. In this paper, we identify and derive accurate, easy-to-evaluate equations for the coefficients of (ordinary) diffusion, viscosity, thermal conductivity, and thermal diffusion. The paper also serves to introduce and supplement the standard references on the subject for readers who are relatively new to the field. GRA

N81-17393# Los Alamos Scientific Lab., N. Mex.
COMPUTER GRAPHICS IN HEAT-TRANSFER SIMULATIONS
G. A. Hamlin, Jr. 1980 7 p refs Presented at conf. on Modeling of Casting and Welding Processes, Runge, N.H., Aug. 1980
(Contract W-7405-eng-36)
(LA-UR-80-3161; CONF-800881-1) Avail: NTIS HC A02/MF A01

Several types of graphics devices are discussed with respect to their use in the setup of heat transfer simulations as well as in the display of the result of such simulations. Some configurations of graphics equipment are presented in the low, medium, and high price ranges. DOE

N81-17394# National Water Well Association, Worthington, Ohio.
GROUND-WATER HEAT PUMPS: AN EXAMINATION OF HYDROGEOLOGIC, ENVIRONMENTAL, LEGAL, AND ECONOMIC FACTORS AFFECTING THEIR USE. VOLUME 1: MAIN TEXT, APPENDICES A, B, AND C
D. M. Armitage, Douglas J. Bacon, John T. Massey-Norton, and James M. Miller 12 Nov. 1980 280 p refs
(Contract DE-AC01-78CS-20060)
(DOE/CS-20060/5120-Vol-1) Avail: NTIS HC A13/MF A01

Groundwater is attractive as a potential low temperature energy source in residential space conditioning applications. When used in conjunction with a heat pump, ground water can serve as both a heat source and a heat sink. Major hydrogeologic aspects that affect system use include groundwater temperature and availability at shallow depths as these factors influence operational efficiency. Ground water quality is considered as it affects the performance and life expectancy of the water side heat exchanger. Environmental impacts related to groundwater heat pump system use are most influenced by water use and disposal methods. In general, recharge to the subsurface is recommended. Legal restrictions on system use are often stricter at the municipal and county levels than at state and federal levels. Computer simulations indicate that under a variety of climatologic conditions, groundwater heat pumps use less energy than conventional heating and cooling equipment. Life cycle cost comparisons with conventional equipment depend on alternative system choices and well cost options included in the groundwater heat pump system. DOE

N81-17395# Sandia Labs., Livermore, Calif.
TWO-DIMENSIONAL SEPARATED FLOW: EXPERIMENT AND DISCRETE VORTEX DYNAMICS SIMULATION
W. T. Ashurst, F. Durst, and C. Tropea Oct. 1980 19 p refs Presented at the AGARD Fluid Dyn. Panel Symp. on Computation of Viscous-Inviscid Interactions, Colorado Springs, Colo., 29 Sep. - 1 Oct. 1980 Prepared in cooperation with Karlsruhe Univ., West Germany
(Contract DE-AC04-76DP-00789)
(SAND-79-8830; CONF-8009104-1) Avail: NTIS HC A02/MF A01

A Laser Doppler Anemometer (LDA) was used to measure the time averaged flow properties and their fluctuations in an open water channel test section. Experimental results include the flow and normal direction velocities (mean and root mean square), Reynolds shear stress, and separated flow length. The variation of the reattachment location was also obtained as a function of Reynolds number and flow expansion ratio. Flow visualization was employed to gain further understanding of the flow structure. Numerical results obtained with a method known as discrete vortex dynamics are described. This method provides a Lagrangian description of fluid flow in which the distribution of vorticity is discretized and its time dependent motion is calculated. Thus, unsteady flow phenomena can be included within this time dependent computational method. DOE

N81-17396# Centre Technique des Industries Mecaniques, Senlis (France).
BIBLIOGRAPHY AND ANALYSIS OF CALCULATION METHODS FOR HEAT EXCHANGERS. PART 3: CALCULATION METHODS INCLUDING TUBE BENDING [ANALYSE BIBLIOGRAPHIQUE DES METHODES DE CALCUL D'ECHANGEURS DE CHALEUR. TROISIEME PARTIE: METHODES DE CALCUL PRENANT EN COMPTE LA FLEXION DES TUBES]
F. Osweiller 29 Jan. 1980 74 p refs In FRENCH
(CETIM-14-B-03-Pt-3) Avail: NTIS HC A04/MF A01

Membrane analogies applicable to the calculation of tube heat exchanger structural behavior are considered. Topics include: (1) the rational analysis of heat exchanger tube-sheet stresses, (2) axisymmetrical bending of circular plates under simultaneous action of lateral load, force in the middle plane and elastic

foundations; (3) fixed tube sheet heat exchangers; (4) heat exchanger tube sheet design (three U-tube and bayonet-tube sheets); (5) a calculation method for tube sheets in straight tube heat exchangers; and (6) and analysis method for heterogeneous structures. The computer codes corresponding to these methods are listed in the bibliography. Author (ESA)

N81-17397# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

AN INTEGRAL METHOD FOR CALCULATING THREE DIMENSIONAL, LAMINAR, COMPRESSIBLE, ADIABATIC BOUNDARY LAYERS [EIN INTEGRALVERFAHREN ZUR BERECHNUNG DREIDIMENSIONALER, LAMINARER, KOMPRESSIBLER, ADIABATER GRENZSCHICHTEN]

H. W. Stock and H. P. Horton Bonn Bundesmininisterium fuer Verteididung 1979 78 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteididung (BMVg-FBWT-79-29) Avail: NTIS HC A05/MF A01; DOKZENTBW, Bonn DM 30

An integral method for calculating three dimensional boundary layers in curvilinear, orthogonal, and nonorthogonal coordinates is described. The method is not restricted to small cross flows. For the evaluation of the integral thicknesses, one parameter velocity profiles for the main stream direction and two parameter velocity profiles for the cross flow direction are used. The one parameter profile family is based on similarity solutions of the boundary layer equations. The two parameter profile family results from a polynomial expression where no boundary conditions of the Pohlhausen type are applied. The x and y momentum and x and y moment of momentum integral equations are used for the solution. For the case of orthogonal coordinates, first order moment of momentum equations are introduced. For nonorthogonal coordinates, first order moment of momentum equations do not produce solutions even when multiplying the momentum equations by linear combinations of the velocity components. For curvilinear, nonorthogonal coordinates, second order moment of momentum equations are developed. Author (ESA)

N81-17398# Messerschmidt-Boelkow G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.

THE STATE OF THEORETICAL METHODS FOR COMPUTING SEPARATED FLOW [DER STAND THEORETISCHER METHODEN ZUR BERECHNUNG ABGELOESTER STROEMUNGEN]

P. Sacher 17 Sep. 1979 56 p refs In GERMAN Presented at DGLR Symp. on Stroemungen mit Ablosung, Munich, 19-20 Sep. 1979 (MBB-FE-122/S/PUB/12; DGLR-79-062) Avail: NTIS HC A04/MF A01

Physical and numerical methods of modeling flow regimes are surveyed. These are, principally, the potential theory model, the boundary layer model, empirical methods, and the Navier-Stokes equation. Generalized applications of each of these methods are listed. Examples centering on symmetrical bodies, rotary wings, aircraft configurations, and ground vehicle configurations are given, illustrating each application. Author (ESA)

N81-17399# Lille Univ. (France). Inst. de Mecanique des Fluides.

UNSTEADY PROPERTIES OF SEPARATED PLANAR FLOWS [PROPRIETES INSTATIONNAIRES DES ECOULEMENTS PLANS DECOLLES]

A. Dyment Paris Association Aeronautique et Astronautique de France 1980 59 p refs In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979 (AAAF-NT-80-05; ISBN-2-7170-0601-X) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 40 (France and EEC) FF 45 (others)

Theory concerning flows about an obstacle at high Reynolds number is reviewed. Past experimentation has shown that modeling in terms of permanent movement is illusory, especially in the supercritical regime. It is shown that this hypothesis is simplifying in nature since the instability domain of the shear layer which follows a separated flow is very small, such that the vortices resulting from the instability seem to originate at the flow separation. Unsteady phenomena consecutive with this vortex generation are elucidated, successive agglomerations of vortices in the mixing zone are explained and conditions for formation of alternating vortex streets in the wake are clarified. Author (ESA)

N81-17400# Societe Bertin et Cie, Plaisir (France).

PHENOMENOLOGY OF UNSTEADY SEPARATED FLOW [PHENOMENOLOGIE DU DECOLLEMENT INSTATIONNAIRE]

M. Sagner and N. Baudu Paris Association Aeronautique et Astronautique de France 1980 25 p refs In FRENCH Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979 (Contracts DRET-67-576; DRET-70-094; DRET-71-283; DRET-72-892; DRET-76-277) (AAAF-NT-80-06; ISBN-2-7170-6102-8) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

A phenomenological description of the generation of a wake, starting at rest, and a qualitative interpretation are presented. Numerical simulation models which make use of free vortices are then discussed in terms of applications. Experimental observations of the generation of separating wakes downstream of various obstacle forms are described. Results lead to principles of numerical modeling of this type of flow based on a description of wakes as vortex singularities. Author (ESA)

N81-17401# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. en Mecanique et Energetique des Systemes.

QUANTITATIVE VISUALIZATION BY VIDEO TECHNIQUES OF RECIRCULATIVE FLOW IN A HYDRODYNAMIC CHANNEL [VISUALISATIONS QUANTITATIVES PAR TECHNIQUES VIDEO, D'ECOULEMENTS A RECIRCULATION EN CANAL HYDRODYNAMIQUE]

Patrick Hebrard, Andre Giovannini, Guy Toulouse, and Pierre Calvet Paris Association Aeronautique et Astronautique de France 1980 18 p refs In FRENCH; ENGLISH summary Presented at 16th Colloq. d'Aerodyn. Appl., Lille, 13-15 Nov. 1979 (AAAF-NT-80-20; ISBN-2-7170-0616-8) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 30 (others)

Fundamental mixing and flow distribution characteristics, applicable to aerodynamic studies of combustion chambers, were observed using video equipment and hydraulic simulation. Experiment data were statistically treated by computer. A residence time distribution function and a flow repartition representation were obtained, then used to build a phenomenological flow model of mixing processes in the employed and is shown to require less memory capacity than a Lagrangian approach to extracting a mean signal. Author (ESA)

N81-17402# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

COMPARISON OF VARIOUS SCHEMES FOR THE GENERATION OF THE TURBULENT INTERMITTENCY FUNCTION

Kin-Choong Muck Mar. 1980 57 p refs (IC-Aero-80-03; ISSN-0308-7247) Avail: NTIS HC A04/MF A01

The velocity intermittency scheme which uses simple functions of fluctuating velocities as a means of distinguishing between turbulent and nonturbulent fluid has several inherent difficulties, which are discussed. The success of the scheme depends on the choice of criterion functions, the threshold settings, the size of the hold time and how it is incorporated, and the amplitude of noise in the turbulent signals. A velocity scheme based on the ultraviolet fluctuations is found to be least affected by the inherent difficulties and generally shows good agreement with the more reliable temperature scheme which makes use of heat to tag the turbulent fluid. Author (ESA)

N81-17403# Massachusetts Inst. of Tech., Cambridge. Energy Lab.

A MONTE CARLO METHOD FOR THE PDF (PROBABILITY DENSITY FUNCTIONS) EQUATIONS OF TURBULENT FLOW

S. B. Pope Feb. 1980 59 p refs (PB81-116444; MIT-EL-80-012) Avail: NTIS HC A04/MF A01 CSCL 20D

The transport equations of joint probability density functions

(pdfs) in turbulent flows are simulated using a Monte Carlo method because finite difference solutions of the equations are impracticable, mainly due to the large dimensionality of the pdfs. Attention is focused on equation for the joint pdf of chemical and thermodynamic properties in turbulent reactive flows. It is shown that the Monte Carlo method provides a true simulation of this equation and that the amount of computation required increases only linearly with the number of properties considered. Consequently, the method can be used to solve the pdf equation for turbulent flows involving many chemical species and complex reaction kinetics. Monte Carlo calculations of the pdf of temperature in a turbulent mixing layer are reported. These calculations are in good agreement with the measurements of Batt (1977). GRA

N81-17404*# New Mexico Univ., Albuquerque. Technology Application Center.
BOUNDARY LAYER EQUATIONS. CITATIONS FROM THE INTERNATIONAL AEROSPACE ABSTRACTS DATA BASE
Progress Report, 1975 - May 1980
Gerald F. Zollars Oct. 1980 63 p Supersedes NTIS/PS-79/0651
Sponsored by NASA and NTIS
(NASA-CR-163954; PB81-800062; NTIS/PS-79/0651) Avail: NTIS HC $30.00/MF $30.00 CSCL 20D

These citations from the international literature cover applications and calculations of boundary layer equations. Included are equations for laminar boundary layers, for two dimensional and three dimensional boundary layers, compressible and incompressible boundary layers, and turbulent boundary layers. GRA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N81-17405*# Barnes Engineering Co., Stamford, Conn.
SELENIUM IMMERSED THERMISTOR BOLOMETER STUDY
Final Technical Report, Sep. 1978 - Mar. 1979
W. H. Rolls 16 Jun. 1979 40 p
(Contract NAS5-25319)
(NASA-CR-160013; BEC-2774) Avail: NTIS HC A03/MF A01 CSCL 14B

The noise characteristics of thermistor bolometers immersed in layers of arsenic/selenium glass which are uniform in composition were examined. Using a controlled deposition technique, layers of glass were deposited, thermistor bolometers immersed, and their electrical characteristics measured after various thermal treatments. Markedly improved stability of the detector noise was observed using this technique. R.C.T.

N81-17406*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FORCE INSTRUMENTATION FOR CRYOGENIC WIND TUNNELS USING ONE-PIECE STRAIN-GAGE BALANCES
Technical Memorandum, Apr. 1977 - Nov. 1979
Alice T. Ferris Jun. 1980 18 p
(NASA-TM-81845) Avail: NTIS HC A02/MF A01 CSCL 14B

The use of cryogenic temperatures in wind tunnels to achieve high Reynolds numbers has imposed a harsh operating environment on the force balance. Laboratory tests were conducted to study the effect cryogenic temperatures have on balance materials, gages, wiring, solder, adhesives, and moisture proofing. Wind tunnel tests were conducted using a one piece three component balance to verify laboratory results. These initial studies indicate that satisfactory force data can be obtained under steady state conditions. Author

N81-17407# Environmental Research Inst. of Michigan, Ann Arbor.
HOLOGRAPHIC IMAGING THROUGH SCATTERING MEDIA
Final Report, 27 Jun. 1979 - 26 Jan. 1980
Anthony M. Tai and Carl C. Aleksoff Oct. 1980 91 p refs
(Contract DAAK11-79-C-0073)
(AD-A093480; AD-E430550; ERIM-143400-4-F; ARBRL-CR-00439) Avail: NTIS HC A05/MF A01 CSCL 14/5

Holographic techniques for imaging through scattering media are reviewed. The concept of an imaging grating interferometer is introduced and its performance in imaging through scattering media is evaluated. The interferometric system is shown to be relatively insensitive to normal vibration and air disturbance. System design and fabrication techniques for the imaging grating interferometer are presented. GRA

N81-17408# Naval Coastal Systems Lab., Panama City, Fla.
CALIBRATION OF SONIC FLOWMETERS FOR OCEAN THERMAL ENERGY CONVERSION (OTEC)
D. F. Lott, G. G. Salsman, and C. E. Hodges Dec. 1980 36 p refs
(Contract ET-78-I-01-3218)
(AD-A093940; NCSC-TM-295-80) Avail: NTIS HC A03/MF A01 CSCL 14/2

Scientists at the Naval Coastal Systems Center (NCSC) at Panama City, Florida, have used a commercially available acoustic flowmeter to monitor critical flow conditions during an OTEC (Ocean Thermal Energy Conversion) funded study of the effects of biofouling on the efficiency of a prototype heat transfer system. Flowmeters of this type are particularly useful in applications requiring unimpeded flow; i.e., no sensor projecting into the moving fluid. Unfortunately, sonic flowmeters are somewhat difficult to calibrate and may be subject to drift. A method of calibration devised by NCSC may thus be of some interest to other users. It is the purpose of this report to document the special procedures used by test personnel to calibrate the flowmeters. Briefly, the calibration consisted of pumping sea water through the flowmeter into a tank suspended beneath a special load cell which provided an output voltage proportional to the weight of water in the tank. A programmable desktop calculator system was used to monitor changes in voltage as a function of time and convert these changes into flow rates for direct comparison with values read from the sonic flowmeter's digital display. Calibration checks were made at metered flows of 8, 10, 12, 14, 16, and 18 gallons per minute (gpm). It was found that computed flows were essentially linear but differed from metered values by as much as 9.0 percent. GRA

N81-17409# Chicago Aerial Industries, Inc., Barrington, Ill.
SHARED FOCAL PLANE INVESTIGATION FOR SERIAL FRAME CAMERAS Technical Report, Sep. 1979 - Mar. 1980
Douglas N. DeFoe Mar. 1980 158 p refs
(Contract N62269-79-C-0801)
(AD-A093403; CAI-7506-0020; NADC-80053-60) Avail: NTIS HC A08/MF A01 CSCL 14/5

Existing serial frame film cameras can be retrofitted to include an E-O focal plane array providing simultaneous collection or both film and real-time E-O imagery. GRA

N81-17410# Oak Ridge National Lab., Tenn. Presented at Ind. Hygiene and Occupational Med. in Coal Conversion Project Workshop, Washington, D.C., 7 Nov. 1980
BIOLOGICAL EXPOSURE SENSORS IN COAL CONVERSION TECHNOLOGIES
A. S. Garrett, Jr. 1980 9 p refs
(Contract W-7405-eng-26)
(CONF-801143-1) Avail: NTIS HC A02/MF A01

A surveillance package appropriate to the special needs for those exposed to effects of coal conversion technologies was proposed. The monitoring program to evaluate the health of the population exposed to the chemical constituents of conversion products, effluents, process stream contents or wastes is described. Particular attention is paid to polycyclic aromatic hydrocarbons. DOE

N81-17411# Varian Associates, Palo Alto, Calif. Microwave Tube Div.
THE 60 GHz GYROTRON DEVELOPMENT PROGRAM Quarterly Report, Apr. - Jun. 1980
J. F. Shively, T. J. Grant, D. S. Stone, R. S. Symons, and G. E. Wendell 1980 44 p refs
(Contract W-7405-eng-26)
(ORNL/Sub-79/21453/4; QR-4) Avail: NTIS HC A03/MF A01

The objective of this program is to develop a microwave oscillator capable of producing 200 kW of CW output power at 60 GHz. The use of cyclotron resonance interaction is being pursued. The design and early procurement and construction phases of this program are discussed. DOE

N81-17412# Rollei-Werke, Franke and Heidecke, Brunswick (West Germany). Zentrale Entwicklung.
DEVELOPMENT OF A 35 MM SINGLE-LENS-REFLEX CAMERA SYSTEM WITH DYNAMIC THROUGH-THE-LENS METERING AND ELECTRONICALLY CONTROLLED APERTURE AUTOMATICALLY Final Report
Friedrich Papke Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 23 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-111; ISSN-0340-7608) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5,05

A single-lens-reflex camera was modified to incorporate an automatic F-stop mechanism. The proper aperture is obtained by a regulating process with dynamic through-the-lens measurement while the diaphragm is closing. Due to this design, lenses with nonlinear diaphragm closing devices and various aperture characteristics can be used. Author (ESA)

36 LASERS AND MASERS

Includes parametric amplifiers.

N81-17413*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
ATMOSPHERIC LIDAR FOR AMPS Progress Report, Sep. 1975 - Jan. 1976
T. J. McIlrath and T. D. Wilkerson 1976 43 p refs
(Contract NAS5-22527)
(NASA-CR-166626; PR-1; PR-3) Avail: NTIS HC A03/MF A01 CSCL 20E

The lidar equation was combined with atomic parameters of species which might be of interest for a spaceborne lidar, in order to estimate signal strength. The results are expressed in a form which can easily be scaled for different assumed abundances and operational parameters. This allows comparison with estimates of other groups. The list of species was limited to those which are of atmospheric interest. The lidar equation considered was the form derived for a Gaussian shaped laser pulse of full width at half intensity delta lambda sub L centered on a Gaussian absorption line of full width at half maximum of delta lambda sub D. T.M.

N81-17414*# TAI Corp., Huntsville, Ala.
STABILIZED ZEEMAN SPLIT LASER Final Report
1981 13 p refs
(Contract NAS8-34036)
(NASA-CR-161637) Avail: NTIS HC A02/MF A01 CSCL 20E

The development of a stablized Zeeman split laser for use in a polarization profilometer is discussed. A Hewlett-Packard laser was modified to stabilize the Zeeman split beat frequency thereby increasing the phase measurement accuracy from the Hewlett-Packard 3 degrees to an accuracy of .01 degrees. The addition of a two layered inductive winding converts the laser to a current controlled oscillator whose frequency is linearly related to coil current. This linear relationship between coil current and laser frequency permits phase locking the laser frequency to a stable crystal controlled reference frequency. The stability of the system is examined and the equipment operation procedures are outlined. M.G.

N81-17415# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Missile Structures Directorate.
APERTURE ANALYSIS OF LASER SPECKLE INTERFEROGRAMS
John A. Schaeffel, Jr. 26 Aug. 1980 23 p refs
(AD-A092895; AD-E950060; DRSMI-RL-80-11-TR) Avail: NTIS HC A02/MF A01 CSCL 14/5

This report documents a new simple system for analyzing laser speckle interferograms for deformation data. In the process the diffracted light from a laser speckle interferogram placed in a collimated light field is selectively mapped into a viewing plane using an aperture. The result is a fringe pattern in the viewing plane which can be easily interpreted for displacement data. The system gives very accurate results. GRA

N81-17416# Battelle Columbus Labs., Ohio.
INVESTIGATION OF LASER SHOCK PROCESSING, VOLUME 2 Final Report, Jul. 1978 - Oct. 1979
S. C. Ford, B. P. Fairand, A. H. Clauer, and R. D. Galliher Aug. 1980 137 p refs
(Contract F33616-78-C-3217; AF Proj. 2401)
(AD-A092977; AFWAL-TR-80-3001-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 11/6

The objective of the program was to demonstrate that laser shock processing is a viable method of improving the fatigue and crack growth performance of mechanically fastened joints. It was shown that a decrease in crack growth rate can be achieved under specified conditions. These conditions involve compressive residual stress (induced by the process) which modify the crack shape and reduce the stress intensity factor. 2024-T3 aluminum alloy reacted better to the process than 7075-T6 aluminum. Results were better in thin (.125 inch) than thick (.250 inch) material. Initial design environmental and cost studies indicate that a laser shock processing system for use on a production line is feasible. GRA

N81-17417# Bell Aerosystems Co., Buffalo, N. Y.
NUMERICAL MODEL DEVELOPMENT FOR LASER CAVITY FLOWFIELDS Final Report, 31 May 1979 - 31 May 1980
J. T. Schimke Bolling AFB, Washington, D.C. AFOSR May 1980 73 p refs
(Contract F49620-77-C-0076; AF Proj. 2304)
(AD-A093059; AFOSR-80-1206TR) Avail: NTIS HC A04/MF A01 CSCL 20/5

A recently developed subroutine package for the integration of systems of differential-algebraic equations by implicit methods is used to compute solutions to Burger's equation. Burger's equation is discretized in space by finite difference methods to produce the differential-algebraic system. The finite differencing scheme provides for the continous automatic variation of the finite difference mesh during the course of the integration. A variety of numerical examples is presented and comparison is made with previously computed fixed mesh solutions. GRA

N81-17418# Naval Research Lab., Washington, D. C.
THEORY OF THE QUASI-OPTICAL ELECTRON CYCLOTRON MASER
P. Sprangle, J. L. Vomvoridis, and W. M. Manheimer 2 Dec. 1980 47 p refs
(RR0110941)
(AD-A092956; NRL-MR-4366) Avail: NTIS HC A03/MF A01 CSCL 20/5

In this work, a promising new electron cyclotron wear oscillator is proposed and analyzed. The configuration utilizes an open resonator cavity containing a gyrating electron beam which translates along an external magnetic field. The magnetic field is directed perpendicular to the axis of symmetry of the open resonator. Because the wave-particle interaction volume is extremely large, the total input electron beam power can be high and the power density low. GRA

N81-17419# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
TRANSIENT REFRACTIVE INDEX IN A XeF LASER Final Report, Oct. 1978 - Sep. 1980

Allen E. Fuhs, James Etchechury, Lonnie Cole, and Gregory A. Blaisdell 30 Sep. 1980 45 p refs Presented at the Ann. Meeting of the Opt. Soc. of Am., Chicago, 14-17 Oct. 1980
(DARPA Order 3747)
(AD-A093275; NPS67-80-012) Avail: NTIS HC A03/MF A01 CSCL 20/5

Transient refractive index was calculated for an e-beam pumped XeF laser having initial concentrations Ne:Xe:NF3::95:5:4:3:0.2. The calculation used Ne in excited states including the transition array 3s yields 4p and all other constituents in ground state. Lines in 3s yields 4p array may be resonant with XeF radiation. To obtain the transient populations for Ne, a modification was made to a Naval Research Laboratory computer code which typically accounts for 180-200 reactions involving 50-60 different species. The modified program included populations in 12 electronic configurations of Ne. Electron beam current was changed 10% at constant voltage to simulate the influence of a hibachi shadow. For a nonresonant laser wavelength, an optical pathlength in the laser, L, less than 35 meters will have distortion delta/lambda less than 0.1; however, for a laser wavelength in resonance with Neon, L of only 0.11 meter will cause delta/lambda = 0.1. The difference in optical pathlength is delta. GRA

N81-17420# GTE Labs., Inc., Waltham, Mass.
NONLINEAR INTERACTIONS BETWEEN LASER RADIATION AND SPIN-ALIGNED CARRIERS IN SEMICONDUCTORS Final Report
E. J. Johnson, R. W. Davies, and A. Lempicki 25 Nov. 1980 97 p refs
(Contract F49620-78-C-0082; AF Proj. 2306)
(AD-A093652; AFOSR-80-1324TR) Avail: NTIS HC A05/MF A01 CSCL 20/5

The central theme of this work is the effect of radiation upon the vector orientation of characteristic properties of photo-excited carriers in semiconductors. The orientation is referred to the direction of propagation and the polarization state of the exciting light. Initially the emphasis was on the optical properties of spin-aligned electrons, particularly their behavior in stimulated emission. The scope was extended to include ordering of orbital angular moments and electron wave vectors as well. The material of choice was GaAs, now rapidly emerging as most important for a variety of optical, electronic and optoelectronic applications. The work performed falls into three categories: (a) development of novel experimental techniques (b) development of new theoretical approaches and (c) development of improved material. In the short duration of this contract the work remains incomplete; however, we have made progress of considerable consequence in the areas where we had anticipated difficulty, thus providing a longer term challenge. GRA

N81-17421# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
PHOTOGENERATION OF VERY ACTIVE HOMOGENEOUS CATALYSTS USING LASER LIGHT EXCITATION OF IRON CARBONYL PRECURSORS Interim Technical Report
James C. Micthener and Mark S. Wrighton 29 Dec. 1980 21 p refs Submitted for publication
(Contract N00014-75-C-0880; NR Proj. 051-579)
(AD-A093976; ONR-TR-24) Avail: NTIS HC A02/MF A01 CSCL 20/5

To summarize our main findings, we conclude that photolysis of Fe(CO)5 or Fe3(CO)12 yeidls an exceedingly active catalyst. The active catalyst is likely not an excited state species since the excited lifetimes of Fe(CO)5 or Fe3(CO)12 are too short to effect catalysis. The active species is likely an unsaturated ground state species photoproduced by loss of CO from Fe(CO)5 or Fe-Fe bond cleavage in Fe3(CO)12. Very high turnover rates for alkene isomerization and hydrosilation have been found. Moreover, very high turnover numbers (moles of product per mole of Fe initially present) are achieved. For example, when a single flash yields approximately 50% conversion of neat 1-pentene using approximately .01 m Fe(CO)5, the turnover number exceeds 400. Subsequent flashes yield an even greater extent conversion to ultimately completely equilibrate the linear pentenes. High light intensity does not appear to alter the product distribution where a number of products are possible (alkene - HSiEt3). The data show that very high light intensity can be used to produce product at a high observed rate and with high quantum efficiency (much greater than 1). GRA

N81-17422# Heriott-Watt Univ., Edinburgh (Scotland). Dept. of Physics.
SUBMILLIMETER LASER AND FABRY-PEROT SPECTROSCOPY USING METALLIC MESH Annual Technical Report, 1 Jun. 1979 - 31 May 1980
C. R. Pidgeon and B. W. Davis May 1980 14 p refs
(Grant DA-ERO-78-G-074)
(AD-A093507; ATR-2) Avail: NTIS HC A02/MF A01 CSCL 20/5

An optically pumped submillimeter laser has been designed and the laser resonator constructed. The objective was to produce a laser which could accommodate a wide range of waveguides and output coupling forms, yet still retain consistent performance over the whole range from 40 micrometers to 1.2 mm. The performance expected was a large number of emission lines over the described range with output powers in excess of 1 mW. Experience from other submillimeter laser systems used led to the choice of a 25 mm I/D dielectric waveguide with a 5 mm diameter pinhole type output coupler as the basis of the optical resonator. A novel mirror translator system, in the form of a 'wobble stick', has been designed and successfully operated in the laser. Such power levels as described were ahcieved using the CO2 pump laser described in the 1st Annual Technical Report. A two-element Low Pass Blocking Filter which was designed and constructed for use in conjunction with the submillimeter laser has been successfully applied to help identify the 170.6 micrometers emission line from CH3OH pumped with 9P36 CO2 transition. The more powerful 118.8 micrometer emission line was effectively blocked, although still lasing, since the filter was external to the laser cavity. GRA

N81-17423# BDM Corp., Albuquerque, N. Mex. Applied Optics Branch.
CHEMICAL LASER COMPUTER CODE SURVEY
Carl M. Wiggins, Dennis N. Mansell, Peter B. Ulrich, and Jon L. Walsh 1 Dec. 1980 277 p refs
(Contract N00173-79-C-0109)
(AD-A093540; NRL-8450) Avail: NTIS HC A13/MF A01 CSCL 20/5

A survey of modeling capability for predicting chemical laser performance has been carried out. Optics, kinetics and gasdynamics codes are included in the survey. Seventy-eight separate codes developed at thirteen research centers are covered in this report. Both quick-look summaries and more in-depth summary sheets have been prepared for each code. A supplementary narrative section provides introductory material concerning code features and capabilities as well as explanation of terminology used on the survey forms. This document is intended as a comparison of code features and as an introduction to capabilities of individual codes. GRA

N81-17424# Battelle Columbus Labs., Ohio.
INVESTIGATION OF LASER SHOCK PROCESSING. VOLUME 1: EXECUTIVE SUMMARY Final Report, Jul. 1978 - Oct. 1979
S. C. Ford, B. P. Fairand, A. H. Clauer, and R. D. Galliher Wright-Patterson AFB, Ohio AFWAL Aug. 1980 16 p refs
(Contract F33615-78-C-3217; AF Proj. 2401)
(AD-A092976; AFWAL-TR-80-3001-Vol-1) Avail: NTIS HC A02/MF A01 CSCL 20/5

The objective of the program was to demonstrate that shock processing is a viable method of improving the fatigue and crack growth performance of mechanically fastened joints. It was shown that a decrease in crack growth rate can be achieved under specified conditions. These conditions involve compressive residual stress (induced by the process) which modify the crack shape and reduce and stress intensity factor. 2024-T3 aluminum alloy reacted better to the process than 7075-T6 aluminum. Results were better in thin (.125 inch) than thick (.250 inch) material. Initial design environmental and cost studies indicate that a laser shock processing system for use on a production line is feasible. GRA

N81-17425# Defence Research Establishment, Ottawa. (Ontario). Defence Electronics Div.

SYSTEM SENSITIVITY ANALYSIS ACOUSTO-OPTIC SPECTRUM ANALYSIS RECEIVER

J. P. Lee Feb. 1980 39 p refs
(AD-A092938; DREO-TN-80-18) Avail: NTIS HC A03/MF A01 CSCL 14/2

This paper examines the system sensitivity of the acousto-optic spectrum analysis receiver for pulse-modulated CW signals with different pulse-widths. Considerations are given on such determining factors as the time-bandwidth product and the integration time of the photo-detector array. Measurements were taken and found to agree well with theory. GRA

N81-17426# Brookhaven National Lab., Upton, N. Y. Chemistry Dept.

PRIMARY EVENTS IN BIOLOGY PROBED BY ULTRAFAST LASER SPECTROSCOPY. CHAPTER 3: ELECTRON TRANSFER REACTIONS IN PHOTOSYNTHETIC BACTERIA

Thomas L. Netzel 1980 70 p refs
(Contract DE-AC02-76CH-00016)
(BNL-28439) Avail: NTIS HC A04/MF A01

Both bacteria and plants use arrays of pigments as antennae to harvest the Sun's energy. This harvested energy is transferred to sites called reaction centers (RCs). The elementary chemical reactions in RCs are electron transfer (ET). The present understanding of RC electron transfer steps is described. Modeling work was performed to correlate electrochemical, spectroscopic, and geometric parameters to help predict the likelihood of electron transfer reactions. To summarize the modeling work, the cofacial diporphyrin models compare favorably with natural photosystems. The distances and rates of ET are similar, and both store greater than 90% of the incident photons energy in ET products. These conclusions lend strong support to RC electron transfer schemes that employ an electron transfer intermediate between BChl)2 and BPheo. The modeling studies suggest that a close to cofacial arrangement may be necessary for rapid electron transfer even at donor to acceptor separations of greater than 7A. DOE

N81-17427# Sandia Labs., Albuquerque, N. Mex. Digital Systems Development Div.

DATA-ACQUISITION AND REAL-TIME TEST-CONTROL SYSTEM FOR SANDIA'S LASER TRACKER

Kenneth C. Bauhs Mar. 1980 57 p ref
(Contract DE-AC04-76DP-00789)
(SAND-80-1623) Avail: NTIS HC A04/MF A01

The Automatic Laser Tracker is the optical analog of a tracking radar. The system used to record and compute data from the laser-tracker shaft encoders and beam-modulating/detector-range electronics used to measure the slant distance to the target is described. These data are used to provide test requesters with position, velocity, acceleration, displacement, closing-rate, and closing-range information in both printed and plotted form. Quick-look data for an average of 9000 space-data coordinates are available within 30 min after an average track test. The most significant capability of the system, however, as its ability to perform certain test functions while the test is under way, based on real time-calculations of the parameters of a moving target. DOE

N81-17428# Naval Research Lab., Washington, D. C.

PREHEAT STUDIES ON LASER ABLATIVELY-ACCELERATED FOILS

E. A. McLean, S. H. Gold, J. A. Stamper, R. R. Whitlock, H. R. Griem, S. P. Obenschain, B. H. Ripin, S. E. Bodner, and M. J. Herbst 13 Oct. 1980 18 p refs
(Contract DE-AI01-77DP-40042)
(NRL-MR-4356) Avail: NTIS HC A02/MF A01

The achievement of laser fusion requires the inward acceleration of pellet shells to very high velocity without excessive preheat of the pellet fuel. In a study of ablatively accelerated thin planar Al foils, the complete time history of the rear surface temperatures were determined and the energy transport mechanisms that contribute to the heating were evaluated. Extrapolation to larger, reactor sized pellets indicates that preheat is minimal at low laser irradiances. DOE

N81-17429# Max-Planck-Gesellschaft, Ploen (West Germany). Projektgruppe fuer Laserforschung.

IODINE AMPLIFIER SYSTEM ASTERIX: CALCULATIONS BASED ON EXPERIMENTS

Michael Nippus May 1979 54 p refs In GERMAN; ENGLISH summary Sponsored in cooperation with Bundesministerium fuer Forschung und Technologie and Euratom
(PLF-17) Avail: NTIS HC A04/MF A01

Using experimental results obtained with iodine laser systems (PLASTERIX and ASTERIX III) a calculation model is constructed. Calculations made on a HP-97 computer show that the energy extraction of an iodine amplifier can be described with sufficient accuracy by the Frantz-Nodvik formula. The influences of various spatial inversion and beam profiles, of extinction losses, and of the tube diameter are evaluated. The optimized physical parameters of an iodine laser system with six amplifiers delivering a power of 40 Terawatts in 300 ps are given in detail. Author (ESA)

N81-17430# Institut Franco-Allemand de Recherches, St. Louis (France).

EXPLOSIVE BOILING OF CYCLOHEXANE INDUCED BY ABSORPTION OF CO2 LASER RADIATION

B. Gautier and R. Joeckle 16 Jan. 1980 11 p refs Presented at 2d Intern. Conf. on Lasers and Appl. Lasers 79, Orlando, Fla., 17-21 Dec., 1979 Sponsored by Direction des Rech., Etudes et Tech. (DRET)
(ISL-CO-202/80) Avail: NTIS HC A02/MF A01

The bulk absorption of CW CO2 laser light by cyclohexane, producing an explosion-like fast growing bubble, was experimentally observed. Measurements of the vaporization rate and of the explosion delay were performed. Experimental results were compared with numerical calculations based on a theoretical model which holds until the explosion occurs. Satisfactory agreement between the superheated liquid calculations and measurements is demonstrated. Author (ESA)

N81-17431# National Bureau of Standards, Washington, D.C. National Engineering Lab.

A SYSTEM FOR MEASURING THE CHARACTERISTICS OF HIGH PEAK POWER DETECTORS OF PULSED CO2 RADIATION

Philip A. Simpson Sep. 1980 48 p refs Sponsored in part by DOD and ONR
(PB81-115487; NBS-TN-1023) Avail: NTIS HC A03/MF A01 CSCL 20E

A system is described for determining the responsivity of detectors for high peak power CO2 laser pulses. The basic approach involves a measurement of the excitation energy and detector output waveform, and is applicable only for pulse amplitudes where the detector output voltage is a linear function of the optical power. A method is described for extending measurements to power levels where the responsivity becomes nonlinear. The time response of hte detectors is checked using short duration (10 ns) rectangular pulses to simulated an impulse. A method for measuring beam diameter is also detailed. An error analysis of the system is given. GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N81-17432* National Aeronautics and Space Administration. Pasadena Office, Calif.

PHASE-ANGLE CONTROLLER FOR STIRLING ENGINES Patent

Allan R. McDougal, inventor (to NASA) (JPL) Issued 23 Dec. 1980 15 p Filed 31 Jan. 1979 Supersedes N79-17217 (17 - 08, p 0987) Sponsored by NASA
(NASA-Case-NPO-14388-1; US-Patent-4,240,256;
US-Patent-Appl-SN-008208; US-Patent-Class-60-518;
US-Patent-Class-74-417) Avail: US Patent and Trademark Office CSCL 13I

An actuator includes a restraint link adapted to be connected with a pivotal carrier arm for a force transfer gear interposed

between the crankshaft for an expander portion of a Stirling engine and a crankshaft for the displacer portion of the engine. The restraint link is releasably trapped hydraulic fluid for selectively establishing a phase angle relationship between the crankshaft. A second embodiment incorporates a hydraulic coupler for use in varying the phase angle of gear-coupled crank fpr a Stirling engine whereby phase angle changes are obtainable.

Official Gazette of the U.S. Patent and Trademark Office

N81-17433* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRESSURE CONTROL VALVE Patent

Kenneth H. Lambson, inventor (to NASA) Issued 16 Dec. 1980 5 p Filed 13 Jul. 1979 Supersedes N79-30553 (17 - 21, p 2817)

(NASA-Case-ARC-11251-1; US-Patent-4,239,057; US-Patent-Appl-SN-057465; US-Patent-Class-137-549; US-Patent-Class-251-339; US-Patent-Class-251-216; US-Patent-Class-128-DIG.20; US-Patent-Class-137-886; US-Patent-Class-137-887) Avail: US Patent and Trademark Office CSCL 13K

A control valve is provided which is adapted to be connected between a pressure source, such as a vacuum pump, and a pressure vessel so as to control the pressure in the vessel. The valve comprises a housing having a longitudinal bore which is connected between the pump and vessel, and a transversely movable valve body which controls the air flow through an air inlet in the housing. The valve body includes cylindrical and conical shaped portions which cooperate with reciprocally shaped portions of the housing to provide flow control. A filter in the air inlet removes foreign matter from the air. The bottom end of the valve body is screwed into the valve housing control knob formed integrally with the valve body and controls translation of the valve body, and the opening and closing of the valve.

Official Gazette of the U.S. Patent and Trademark Office

N81-17434*# General Electric Co., Cincinnati, Ohio.

PROGRAM TO DEVELOP SPRAYED, PLASTICALLY DEFORMABLE COMPRESSOR SHROUD SEAL MATERIALS Final Report, Jul. 1976 - Aug. 1980

J. D. Schell and J. D. Schell Jan. 1980 148 p refs

(Contract NAS3-20054)

(NASA-CR-165237; R80AEG458) Avail: NTIS HC A07/MF A01 CSCL 11A

A study of fundamental rub behavior for 10 dense, sprayed materials and eight current compressor clearance materials was conducted. A literature survey of a wide variety of metallurgical and thermophysical properties was conducted and correlated to rub behavior. Based on the results, the most promising dense rub material was Cu-9A1. Additional studies on the effects of porosity, incursion rate, blade solidity, and ambient temperature were carried out on aluminum bronze (Cu-9Al-1Fe) with and without a 515B Feltmetal underlayer. A further development effort was conducted to assess the property requirements of, a porous, aluminum bronze, seal material. Strength, thermal cycle capabilities, erosion and oxidation resistance, machinability, and abradability at several porosity levels were examined. T.M.

N81-17435*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER PROGRAM DOCUMENTATION FOR THE DYNAMIC ANALYSIS OF A NONCONTACTING MECHANICAL FACE SEAL

B. M. Auer and I. Etsion Nov. 1980 47 p refs

(NASA-TM-81636; E-650) Avail: NTIS HC A03/MF A01 CSCL 11A

A computer program is presented which achieves a numerical solution for the equations of motion of a noncontacting mechanical face seal. The flexibly-mounted primary seal ring motion is expressed by a set of second order differential equations for three degrees of freedom. These equations are reduced to a set of first order equations and the GEAR software package is used to solve the set of first order equations. Program input includes seal design parameters and seal operating conditions. Output from the program includes velocities and displacements of the seal ring about the axis of an inertial reference system. One example problem is described. M.G.

N81-17436*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN OF SPUR GEARS FOR IMPROVED EFFICIENCY

Neil E. Anderson (Army Aviation Research and Development Command, Cleveland) and Stuart H. Loewenthal 1981 17 p refs Presented at ASME Western Design Eng. Conf., Anaheim, Calif., 9-11 Dec. 1980 and proposed for presentation at ASME Design Eng. Conf., Chicago, 27-30 Apr. 1981 Prepared in cooperation with Army Aviation Research and Development Command, Cleveland

(NASA-TM-81625; E-630; AVRADCOM-TR-81-C-3) Avail: NTIS HC A02/MF A01 CSCL 13I

A method to calculate spur gear system loss for a wide range of gear geometries and operating conditions was used to determine design requirements for an efficient gearset. The effects of spur gear size, pitch, ratio, pitch line velocity and load on efficiency were determined. Peak efficiencies were found to be greater for large diameter and fine pitched gears and tare (no-load) losses were found to be significant. R.C.T.

N81-17437*# Rocketdyne, Canoga Park, Calif.

LOW-THRUST CHEMICAL PROPULSION SYSTEM PUMP TECHNOLOGY Final Report, Oct. 1979 - Sep. 1980

J. W. Meadville 20 Oct. 1980 411 p

(Contract NAS3-21958)

(NASA-CR-165210; RI/RD80-222) Avail: NTIS HC A18/MF A01 CSCL 13K

A study was conducted within the thrust range 450 to 9000 N (100 to 2000 pounds). Performance analyses were made on centrifugal, pitot, Barske, drag, Tesla, gear, piston, lobe, and vane pumps with liquid hydrogen, liquid methane, and liquid oxygen as propellants. Gaseous methane and hydrogen driven axial impulse turbines, vane expanders, piston expanders, and electric motors were studied as drivers. Data are presented on performance, sizes, weights, and estimated service lives and costs. T.M.

N81-17438# Ampex Corp., Redwood City, Calif. Advanced Technology Div.

FOIL BEARING INVESTIGATION. 1: SUMMARY OF RESULTS. 2: TECHNICAL REPORT: ANALYSIS OF HYDROSTATIC FOIL BEARINGS INCLUDING THE EFFECTS OF FLUID INERTIA Final Report, 1 Oct. 1976 - 30 Sep. 1980

A. Eshel 30 Nov. 1980 18 p refs

(Contract N00014-77-C-0021; NR Proj. 062-297)

(AD-A092901; ATD-RR-80-12) Avail: NTIS HC A02/MF A01 CSCL 13/9

Analysis is made of planar hydrostatic foil bearings with the inclusion of fluid inertia effects. It is shown that the double valuedness of the pressure-flow characteristics observed in earlier works is attributable to the neglect of fluid inertia effects. These effects alter the bearing behavior qualitatively at high flow rate. GRA

N81-17439# Sonobond Corp., Westchester, Pa.

ULTRASONICALLY ASSISTED MACHINING OF AIRCRAFT PARTS Final Report, Aug. 1978 - Mar. 1980

Janet Devine and Philip C. Krause Oct. 1980 77 p refs

(Contract DAAG46-78-C-0059)

(AD-A092915; USAAVRADCOM-TR-80-F-18; AMMRC-TR-80-50) Avail: NTIS HC A05/MF A01 CSCL 13/8

A tool post for ultrasonic activation of cutting tools on a turret lathe was designed, fabricated and given preliminary evaluation on a LeBlond engine lathe, turning difficult-to-machine wrought metal alloys, including ESR 4340 steel, 4340 steel, 9310 steel, 17-4 PH steel, several titanium alloys and Refractaloy 26. With the ultrasonic assist, metal removal rates were increased by factors up to 730 percent, tool wear and tool breakage were reduced and tool chatter was eliminated. Ultrasonically cut chips had a larger curl radius, lower hardness and less heat discoloration than conventionally cut chips. It was recommended that the ultrasonic tool post be refined and installed on a turret lathe for evaluation in a production environment. GRA

N81-17440# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.

FLUX SHIELDED WELDING OF TITANIUM Annual Report, 1 Aug. 1979 - 31 Jul. 1980
C. Huntington, T. D. Burleigh, L. Wilson, R. Thompson, and A. Block-Bolten 30 Sep. 1980 34 p refs
(Contract N00014-77-C-0569)
(AD-A093945; TR-4) Avail: NTIS HC A03/MF A01 CSCL 11/6

This is the third annual report of studies concerned primarily with submerged arc welding of titanium. During the current period studies have been directed toward recycling fluxes as a means of reducing costs, modification of flux chemistries to improve operating properties, the physics of enhanced weld penetration in the presence of fluxes and a brief evaluation of newly available Soviet literature on the subject. The recycling efforts have been unsuccessful; however, a new purification process which may simplify the procedure has been proposed but has not been tested. Modification to the flux chemistry confirms that the cation activity of the flux is the primary factor contributing to oxygen refining capacity. The tests of enhanced weld penetration are as yet inconclusive. GRA

N81-17441# Oak Ridge National Lab., Tenn.
HEAVY WALL PRESSURE VESSELS FOR ENERGY SYSTEMS
D. A. Canonico 1980 34 p refs Presented at Symp. on Alloys for the 1980's, Ann Arbor, Mich., 17 Jun. 1980
(Contract W-7405-eng-26)
(CONF-8006124-1-Draft) Avail: NTIS HC A03/MF A01

Modifications of steels provide improved mechanical properties. These steels permit the fabrication of larger diameter vessels with thinner section sizes and approved reliability and integrity. Adapting current specifications should expedite Code approval. The challenge of improving welding procedures and adapting processes for field applications will result in higher quality weldments. DOE

N81-17442# United Nuclear Industries, Inc., Richland, Wash.
SOLID: A FINITE ELEMENT AXISYMMETRIC STRESS PROGRAM
P. H. Estes Mar. 1980 55 p refs
(Contract DE-AC06-76RL-01857)
(UNI-1496) Avail: NTIS HC A04/MF A01

The computer program, SOLID, for performing linear stress analysis of axisymmetric structure, subjected to mechanical and thermal loads is presented. SOLID is written in FORTRAN IV for use on the CYBER computer. The finite element method was used with an isoparametric quadrilateral ring element. Solution of the simultaneous equations was done by skyline method after blocking equations according the bandwidth and amount of core specified by user. DOE

N81-17443# Centre Technique des Industries Mecaniques, Senlis (France).
IMPULSE PRESSURE TESTS FOR METRIC SEALS IN ISO-DEFINED JOINTS Final Report [ESSAIS AUX IMPULSIONS DE PRESSION D'UNE IMPLANTATION METRIQUE POUR RACCORDS ISO]
J. L. Lanier 9 Jan. 1980 27 p In FRENCH
(CETIM-14-L-16-0) Avail: NTIS HC A03/MF A01

Following an ISO definition of a hydraulic connector and different modes of sealing, a fluid pressure impulse test for sealing quality was carried out. The as-defined ISO fitting allows for four types of seal, available off the shelf and not requiring any hardware modifications. Seal types are: metal on metal, O ring seal, elastomer-metal composite material O ring seal, and copper O ring gasket. Test conditions involved 500,000 cyclic impulses (amplitude 600 bar) at a frequency of 5Hz. Results show that none of the sealing modes tested are satisfactory for industrial purposes. A redefinition of the fitting is advised. Author (ESA)

N81-17444# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
PHYSICAL AND CHEMICAL PHENOMENA RESPONSIBLE FOR ODOR FORMATION IN DIESEL ENGINES Interim Progress Report, Jul. 1978 - Dec. 1979
N. P. Cernansky, C. W. Savery, I. H. Suffet, and R. S. Cohen Jan. 1980 68 p refs
(Grant NSF DAR-76-19752)
(PB81-119166; NSF/RA-800225) Avail: NTIS HC A04/MF A01 CSCL 07D

Two single cylinder diesel engine tests facilities were modified and instrumented for studying odor formation and control: a CFR prechamber (IDI) engine and a TACOM direct injection (DI) engine. A direct injection head and a 'Comet' type prechamber head for the CFR engine were obtained. An air aspirated spray burner, a prevaporized burner, and a prevaporized, premixed, preignition flow reactor were designed and built. Odor sampling and analysis techniques and procedures were developed and are being refined. More than 990 odor samples were collected and analyzed. Studies show that differences in peak pattern and intensity are observable with changes in odor level, fuel type, and experimental facility. Steady state odor mapping indicates that the DI engine had higher odor emissions than the IDI engine in the current experiments. Changes in operating variables (speed, load, injection angle, etc.) over their normal operating ranges did not significantly affect odor emissions. GRA

N81-17445# Automated Sciences Group, Inc., Silver Spring, Md.
SUPPORT FOR THE ANALYTICAL TOOLS FOR AUTOMOTIVE FUEL ECONOMY ACTIVITIES Final Report, 30 Nov. 1977 - 1 Jul. 1980
William E. Hatch Jun. 1980 78 p refs
(Contract DOT-HS-7-01708)
(PB81-109555; ASG-TR-80-31; DOT-HS-805-518) Avail: NTIS HC A05/MF A01 CSCL 13F

Vehicle certification reports issued by EPA in September and February of each year contain individual emissions tests results. Data on vehicle test weight, engine displacement, dynamometer horsepower setting and fuel economy as computed from the emissions values are included. The certification data were extracted on magnetic tape. GRA

N81-17446# Battelle Columbus Labs., Ohio.
BUTT FUSION JOINING OF DISSIMILAR POLYETHYLENE PIPING MATERIALS
M. J. Cassady, R. L. Markham, and M. M. Epstein Chicago, Ill. Gas Research Inst. 15 Jun. 1980 71 p refs
(Contract GRI-5014-352-0152)
(PB81-113631L; GRI-80/0005) Avail: NTIS HC A04/MF A01 CSCL 13K

Butt fusion joints were prepared from all combinations of three commercial polyethylene piping materials using selected temperatures and joining pressures. An ultrasonic inspection method was used to examine joints for possible flaws. Short-term tests (tensile and twist) were conducted on chosen combinations. All combinations were tested in methane stress rupture tests at 23 C and selected combinations were tested at 49 C. Strength at 100,000 hours was predicted for joined specimens by lineear regression analysis. Scanning electron and option microscopy were used to examine the fracture surface and the area around the failure of several joints. It was found that good joints can be prepared from dissimilar materials. GRA

N81-17447# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CENTRIFUGAL COMPRESSORS, FLOW PHENOMENA AND PERFORMANCE
Nov. 1980 342 p refs In ENGLISH; partly in FRENCH Papers presented at the 55th(B) Specialists' Meeting of the Propulsion and Energetics Panel of AGARD, Brussels, 7-9 May 1980
(AGARD-CP-282) Avail: NTIS HC A15/MF A01

Experimental investigations on flows in impellers and diffusers, theoretical calculations of flows in impellers, interaction between impeller and diffuser, and design experience and performance of advanced centrifugal compressors are discussed. Emphasis is on the inducer, impeller and the diffuser flow field, and on interactions between impeller and diffuser. A comprehensive survey and detailed information on design experience and centrifugal compressor performance are provided. Viscous, transonic, compressible, and three dimensional effects were studied. The influence of nonuniform flow at the rotor outlet on performance and surge margin, namely for high pressure ratio compressors, are discussed. For individual titles, see N81-17448 through N81-17468.

N81-17448# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE INTERNAL FLOW IN A CENTRIFUGAL COMPRESSOR DIFFUSER

H. Krain *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 18 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

A two dimensional straight diffuser was designed and tested based on empirical flat diffuser performance maps. First experimental results concerning overall diffuser recovery, diffuser inlet conditions, and diffuser performance development are presented. A two dimensional finite difference blade-to-blade calculation method was developed taking into account diffuser losses and sidewall blockage. E.D.K.

N81-17449# Cranfield Inst. of Tech., Bedfordshire (England). Fluid Engineering Unit.

FLOW IN CENTRIFUGAL COMPRESSOR IMPELLERS: A THEORETICAL AND EXPERIMENTAL STUDY

A. Goulas *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 17 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

The flow field in various centrifugal compressor impellers is studied both theoretically and experimentally in order to improve the understanding of the flow phenomena involved and to develop numerical methods capable of predicting the complex viscous and turbulent flow field. The circumferential and radial components of velocity and the rms of the correspoinding fluctuations in the impeller of a centrifugal compressor were obtained using a laser Doppler anemometer. The results indicate a two unequal vortex arrangement with opposite direction of rotation and with the smaller vortex immediately behind the suction side of each blade. The radial velocity profiles indicate a weak wake at the center of the passage near the shroud as for curvature dominated flows. The study of the published experimental data points to the vorticity being a dominant feature of the flow inside the impeller. Numerical integration of the vorticity equations shows that the production of streamwise vorticity is affected by the diffusion achieved in the inducer and the length of the radial part of the impeller, both major design parameters. The prediction method is a finite difference scheme based on the matrix through flow analysis as was modified to incorporate the effect of viscosity and turbulence on the flow field. E.D.K.

N81-17450# Societe Creusot-Loire, Le Creusot (France).

EXPERIMENTAL FLOW ANALYSIS IN A STAGE OF CENTRIFUGAL MACHINERY

G. Bois (METRAFLU SARL, Ecully, France), J. M. Duchemin, A. Vouillarmet (Ecole Centrale de Lyon, France), and K. D. Papailiou (National Technical Univ., Athens) *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 30 p refs In FRENCH; ENGLISH summary (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

Experimental results obtained at the exit of the impellers and in the vaneless diffusers of two centrifugal compressors, with and without a cover plate, are presented. Two measurement methods are compared. The first is conventional and uses directional pressure probes, the second rests on the use of a laser system. An attempt is made at analyzing secondary flows using the results of a quasi-three dimensional meridional calculation. The secondary flow approach uses the results already acquired for axial machines, taking fuller account of the additional terms appearing in the formulation. E.D.K.

N81-17451# *Nuovo Pignone S.p.A., Florence (Italy).*

INLET FLOW DISTORTIONS ON INDUSTRIAL CENTRIFUGAL COMPRESSOR STAGES. EXPERIMENTAL INVESTIGATIONS AND EVALUATION OF EFFECTS ON PERFORMANCE

E. Benvenuti, L. Bonciani, and U. Corradini *In* AGARD Centrifugal Compressors, Flow Phenomena and Peformance Nov. 1980 16 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

Results are presented of tests carried out on a stage equipped with three different inlet configurations, two with curved de-swirl vanes and straight vanes, and one with no vanes. Test results show the presence of high intensity wakes downstream of both the curved and straight vanes that are not completely mixed out along the path towards the impeller. Wake mixing is associated with a total pressure loss whose magnitude can be well evaluated from the measurements. Stage efficiency is decreased by the presence of both straight and curved vanes, the decrease being almost the same despite the different wake amplitudes produced by the two types of vanes; the strong wakes from the curved de-swirl vanes decrease the impeller's head coefficient somewhat at high flows. The good repetitiveness and consistency of test results are indications of the reliability of the procedures selected for investigating complex flow fields of this kind and assessing their effect on stage performance. E.D.K.

N81-17452# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

CALCULATING TRANSONIC FLOW IN A CENTRIFUGAL COMPRESSOR USING A PSEUDO-STATIONARY METHOD [CALCUL DE L'ECOULEMENT TRANSSONIQUE DANS UN COMPRESSEUR CENTRIFUGE PAR UNE METHODE PSEUDO-STATIONNAIRE]

Roland Sovrand *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 10 p refs In FRENCH; ENGLISH summary (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

A study of perfect fluid flow through a centrifugal compressor is presented. The calculation of a transonic flow on a blade-to-blade stream surface is emphasized. Based upon the solution of the time dependent Euler equations, the study is directed towards obtaining the steady flow through the blade row. The numerical scheme is a time marching method derived from the MacCormack model, extended at ONERA. This approach, combining an explicit discretization of the equations according to the well known predictor-corrector technique, corresponds to a conservative method, the writing of which is not too difficult. The numerical results are very useful for designing high performance turbomachines. E.D.K.

N81-17453# Numerical Continuum Mechanics, Inc., Woodlawn Hills, Calif.

NUMERICAL ANALYSIS OF THE THREE DIMENSIONAL VISCOUS FLOW FIELD IN A CENTRIFUGAL IMPELLER

Leonard Walitt *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 29 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

The steady three dimensional Reynolds averaged Navier-Stokes equation were solved numerically via a successive approximation method. The method is applicable to centrifugal impellers, axial rotors, turbines, and stator cascades. Viscous flow fields were calculated in a radial impeller, two backswept centrifugal impellers, one with a splitter vane, and an axial supersonic compressor cascade. The radial impeller field contained a significant separation region near the trailing edge of the suction surface, while the backswept fields showed significant leading edge separation and some trailing edge separation near the shroud. Kulite recordings of the shroud pressure variation between the blades in the inducer region and in the radial portion of the backswept impeller with the splitter vane, generally agreed with corresponding calculations. Pressure measurements on the blades of the supersonic compressor cascade agreed with corresponding computations. Author

N81-17454# Vrije Universiteit, Brussels (Belgium).

THREE DIMENSIONAL INVISCID CALCULATIONS IN CENTRIFUGAL COMPRESSORS

Ch. Hirsch, Ch. Lacor, and G. Warzee (Brussels Univ.) *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 11 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

An inviscid, rotational, three dimensional flow model in centrifugal compressors is presented. The three dimensional flow is separated into a potential flow part and a rotational part described by a simple additional function. The solution of the

potential flow part is described and applied to several centrifugal compressors. Results are compared to experimental data as well as to results of a quasi-three dimensional calculation procedure. E.D.K.

N81-17455# Politecnico di Milano (Italy). Istituto di Macchine.

TRANSONIC FLOW CALCULATION IN CENTRIFUGAL COMPRESSORS BY A TIME DEPENDENT METHOD OF CHARACTERISTICS

Carlo Osnaghi, Antonio Perdichizzi, and Francesco Bassi *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 14 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

Difficulties in the numerical solution of the flow in advanced centrifugal compressors arise from the transonic nature of the flow. In order to solve this problem, a time dependent method of characteristics, which takes into account shock waves, boundary layer and wakes, is presented. Separated flow is simulated by simplified models. Such a program is proposed for centrifugal compressors both for impellers and diffusers. Extension of the method to unsteady phenomena is discussed. Results are discussed, and they demonstrate the possibilities of the method at the present state of the art. Author

N81-17456# Virginia Polytechnic Inst., Blacksburg. Dept. of Mechanical Engineering.

THREE-DIMENSIONAL, VISCOUS FLOW CALCULATIONS FOR ASSESSING THE THERMODYNAMIC PERFORMANCE OF CENTRIFUGAL COMPRESSORS: STUDY OF THE ECKARDT COMPRESSOR

John Moore and Joan G. Moore *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 19 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

A calculation procedure for partially parabolic flow is used to calculate flow in the impeller and diffuser of the Eckardt centrifugal compressor. This is a general geometry cascade flow method including the effects of tip leakage and stationary walls. The calculated and experimental results for three dimensional viscous flow and overall thermodynamic performance are compared. Wake flow, resulting from boundary layer accumulation, causes blockage of the impeller passage. Calculated wake development, with and without flow leakage through the tip clearance gap, is compared with measurements. The thermodynamic process in the Eckardt compressor, at the maximum efficiency point at 14000 RPM, is represented on a temperature entropy diagram. Calculated results of the development of mass averaged temperature and entropy through the impeller and diffuser are presented. The work done, the pressure ratios, and the efficiencies of the impeller and compressor are calculated to within 1 or 2%. The influence of the boundary conditions on the compressor flow and performance is discussed. Author

N81-17457# Manchester Coll. of Science and Technology (England). Dept. of Mechanical Engineering.

COMPUTATION OF THREE DIMENSIONAL FLOW THROUGH THE ECKARDT COMPRESSOR IMPELLER

C. Bosman *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 8 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

The inviscid flow through the Eckardt impeller was computed using a time marching technique with primitive variables. Comparison is made at one operating point between the experimental results, computed quasi-three dimensional inviscid results using stream surface techniques, and the computed inviscid three-dimensional results. The computed three dimensional results exhibit the presence of a passage vortex, which is necessarily absent in the quasi-three dimensional solution, and generally show improved agreement with experimental results. The presence of a jet/wake efflux pattern is evident in the three dimensional inviscid solution although its strength is less than that of the experimental result. E.D.K.

N81-17458*# Iowa State Univ. of Science and Technology, Ames. Dept. of Mechanical Engineering.

COMPUTATION OF FLOW IN RADIAL- AND MIXED-FLOW CASCADES BY AN INVISCID-VISCOUS INTERACTION METHOD

George K. Serovy and Elmer C. Hansen (Florida Univ., Gainesville) *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 11 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

The use of inviscid-viscous interaction methods for the case of radial or mixed-flow cascade diffusers is discussed. A literature review of investigations considering cascade flow-field prediction by inviscid-viscous iterative computation is given. Cascade aerodynamics in the third blade row of a multiple-row radial cascade diffuser are specifically investigated. M.G.

N81-17459# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

ROTATING NONUNIFORM FLOW IN RADIAL COMPRESSORS

R. A. VandenBraembussche, P. Frigne, and M. Roustan (Societe Creusot-Loire, Le Creusot, France) *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 14 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

The prediction of rotating instabilities in radial vaneless diffusers is examined. The rotating nonuniformities were experimentally measured by means of hot films, in centrifugal compressors of different geometry and at different Reynolds numbers. Results are compared with other available data and theoretical predictions. The rotating instabilities can be explained by Senoo's theory for reverse flow in radial diffusers, if a correction term in function of Reynolds number is added. First inviscid results obtained with a time-evolutive interaction model are presented. M.G.

N81-17460# Creare, Inc., Hanover, N.H. Fluid Machinery Div.

THE INFLUENCE OF DIFFUSER INLET PRESSURE FIELDS ON THE RANGE AND DURABILITY OF CENTRIFUGAL COMPRESSOR STAGES

David Japikse *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 11 p refs (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

An anomalous range characteristic of two stages differing only in diffuser passage number was investigated. Pressure field data in the diffuser inlet region was examined and a strong shock pressure recovery system was discovered when a low diffuser number is used and a mild shock recovery process resulted when a large diffuser number was employed. When strong shocks were present, it was found that a leading shock set up a subsequent accelerating flow field which stabilized a second shock. In turn, the second shock contributed substantially to the static pressure recovery process in the diffuser inlet region. The combined effect was a highly stabilized flow fields, in agreement with the Kantrowitz shock stabilization criterion. By contrast, the strong shock system contributed to a loss in total pressure of up to 2 deg of the total pressure rise in the stage. Two different stages are discussed where mechanical failure occurred. These cases may be related to the strong shock system of the diffuser inlet region closely coupled to the impeller blade tips. M.G.

N81-17461# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

THE INFLUENCE OF NONUNIFORM FLOW AT A ROTOR OUTLET ON DIFFUSER PERFORMANCES IN A CENTRIFUGAL COMPRESSOR [INFLUENCE DE L'HETEROGENEITE DE L'ECOULEMENT A LA SORTIE DU ROTOR SUR LES PERFORMANCES DU DIFFUSEUR D'UN COMPRESSEUR CENTRIFUGE]

Henri Hus (Hispano Suiza) and Christian Fradin *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 13 p refs In FRENCH; ENGLISH summary (For primary document see N81-17447 08-37)

Avail: NTIS HC A15/MF A01

The performance of the diffuser of a centrifugal compressor is analyzed when the inlet flow is deliberately more or less nonuniform. The measurement of instantaneous values of pressure and velocity by means of pressure transducers and hot-wire

anemometers gives the detailed structure of the flow field. An accurate estimation of the effect of nonuniformities on the performances of the diffuser is derived from the se measurements. They show that the pressure losses are directly related to the nonuniformities. Validation of an overall estimation of diffuser performance from conventional probe measurements is derived from this experiment. M.G.

N81-17462# National Gas Turbine Establishment, Pyestock (England).

DESIGN AND EXPERIMENTAL PERFORMANCE OF SOME HIGH PRESSURE RATIO CENTRIFUGAL COMPRESSORS

P. M. Came and M. V. Herbert *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 31 p refs (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

A design procedure for impellers and diffusers of high pressure ratio centrifugal compressors is described. Particular emphasis is given to a philosophy of design for supersonic inlet, vaned radial diffusers. Test results are presented for several transonic diffusers operating in a 6 1/2 pressure ratio stage. Observations of surge in this and other compressors are used as a basis for a discussion of possible surge mechanisms in centrifugal compressors. Author

N81-17463# Ruhr Univ., Bochum (West Germany). Lefrstuhl fuer Fluidenergiemaschinen.

A PROCEDURE FOR THE COMPUTER-AIDED CONSTRUCTION OF RADIAL COMPRESSOR IMPELLERS WITH HIGH FLOW COEFFICIENT

W. Fister and J. Eikelmann In AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 12 p refs (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

A computer-aided procedure for the construction of radial compressor impellers with high flow-coefficient is presented. The procedure consists of an iterative succession of constructional design, recomputation of fluid-flow-mechanical characteristics and specific geometrical correction based upon the given criteria. The significance of the computational procedures and criteria used is verified on the basis of the operating behavior of two compressor stages. M.G.

N81-17464# Societe Generale de Constructions Electriques et Mechaniques Alsthom-Atlantique, La Courneuve (France).

THE WHEEL OF A CENTRIFUGAL COMPRESSOR WITHOUT BLADE FLEXURE [ROUE DE COMPRESSEUR CENTRIFUGE SANS FLEXION DANS LES AILES]

Jean Poulain and Gilbert Janssens *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 10 p refs In FRENCH; ENGLISH summary (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

A centrifugal compressor with backward leaned blades is presented. The geometry of the compressor is designed in such a way as to eliminate the bending stresses due to centrifugal forces. The compressor was tested in a Freon loop. Due to a theoretical analysis of the test results, an improved version of the compressor was designed. This compressor seems well suited for a multistage configuration and shows a pressure ratio of 4.8 with a polytropic efficiency of 0.83. In a single stage configuration, without the return duct, its pressure ratio is 5.3 with an efficiency of 0.85. M.G.

N81-17465# Northern Research and Engineering Corp., Woburn, Mass.

IMPROVEMENTS IN SURGE MARGIN FOR CENTRIFUGAL COMPRESSORS

W. Jansen, A. F. Carter, and M. C. Swarden *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 17 p refs (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

The performance of stall inhibitor concepts for centrifugal compressors is investigated. Three impeller wall treatments and a vaned diffuser treatment are assessed. The impeller wall treatments were tested on compressor stages that produce a medium pressure ratio of three to one at the design point. Both the impeller and diffuser treatments were applied to a stage that produces a six to one pressure ratio. Specific results are discussed. M.G.

N81-17466# Detroit Diesel Allison, Indianapolis, Ind.

MODEL 250-C30/C28B COMPRESSOR DEVELOPMENT

Dennis C. Chapman *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 6 p (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

The performance of advanced versions of the Allison Model 250 engine series in production for the Sikorsky S76 and Bell Long Ranger helicopters is discussed. These engines, designated 250-C30 and -C28B respectively, use a single stage centrifugal compressor matched at 8.7:1 pressure ratio at design speed. The initial design met flow, pressure ratio, and efficiency requirements, but encountered both a localized deficiency in the surge line around 85% speed and excessive impeller blade vibratory stress at high speed. Several potential remedies were tried unsuccessfully and the compressor was redesigned. The redesign featured redistributed impeller blade loading, revised impeller blade thickness, and increased number of diffuser vanes. These changes eliminated the vibratory stress problem. A unique inducer shroud bleed system, requiring no control, resolved the surge line problem and improved high speed flow and efficiency as well. M.G.

N81-17467# Noel Penny Turbines Ltd., Toll Bar End (England).

CENTRIFUGAL COMPRESSORS FOR SMALL AERO AND AUTOMOTIVE GAS TURBINE ENGINES

R. W. Chevis and R. J. Varley *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 18 p refs (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

Compressor design requirements for three engine types are briefly discussed. These types are the expendable turbojet, the low cost single shaft turbopropeller engine, and the automotive truck gas turbine engine. Technical and test data are presented for representative types of compressors. M.G.

N81-17468# Solar Turbines International, San Diego, Calif.

EFFICIENCY OF CENTRIFUGAL COMPRESSOR IMPELLERS

Colin Rodgers *In* AGARD Centrifugal Compressors, Flow Phenomena and Performance Nov. 1980 14 p refs (For primary document see N81-17447 08-37)
Avail: NTIS HC A15/MF A01

It is argued that improved efficiency correlation of high and low pressure ratio compressors can be obtained, if the impeller and diffuser performances of centrifugal compressors and pumps can be separated. This allows the impeller performance potential to be correlated separately in terms of peak polytropic efficiency versus specific spped based upon average flowpath density. Test data are presented to support the improved correlation, on several compressor impeller geometries at low and high Mach number and specific speed, together with design charts showing attainable state-of-the-art impeller efficiency levels as dependent upon geometry and operating conditions. M.G.

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N81-17469# George Washington Univ., Washington, D.C. Inst. for Management Science and Engineering.

IMPROVEMENT OF KERNEL ESTIMATORS OF THE FAILURE RATE FUNCTION USING THE GENERALIZED JACKNIFE

Nozer D. Singpurwalla and Man-Yuen Wong Feb. 1980 44 p refs
(Contract N00014-77-C-0263)
(AD-A092928; SERIAL-T-415) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper, we explore methods by which the rate of

convergence of the bias and the mean square error of kernel estimators of the failure rate function can be improved. We show that if the kernel is not restricted to be nonnegative, and is suitably chosen, then the bias contribution to the asymptotic mean square error can be eliminated to any required order, and the rate of convergence of the asymptotic mean square error can be brought as close to 1/n as is desired. The generalized jackknife method of combining estimators is shown to be an adequate procedure which leads us to this goal. GRA

N81-17470# Princeton Univ., N. J. Dept. of Statistics.
NEW MODELS FOR RELIABILITY GROWTH Final Report
Henry Braun and Nathaniel Schenker Oct. 1980 43 p refs
(Contract F49620-79-C-0148; AF Proj. 2304)
(AD-A093039; TR-174; AFOSR-80-1217TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Reliability growth modeling is an important component in development testing of complex systems. It provides estimates of the current status of the process as well as forecasts of reliability at future time points. Several models have been investigated in the literature. In this report, we focus on comparing the performance of a model introduced by L. Crow and a family of models which are generalizations of those introduced in Braun and Paine. The novel feature of this latter family is that is models the logarithm of the intensity function of the failure process as a multiple linear regression of some function of the number of different failure modes uncovered and the number of recurrent failures. These models possess great flexibility in accommodating many different shapes of reliability growth curves including nonmonotonic ones. Three members of this family are compared with the Crow model over a range of simulated reliability growth patterns. One member, in particular, seems to provide short-and long term forecasts superior to those of Crow's. These results suggest that these new models be in the modeling of field data. Three such data sets are considered here as well. GRA

N81-17471# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
LIFE TESTING Technical Report, 6 May - 31 Aug. 1980
Nancy R. Mann and Nozer D. Singpurwalla Aug. 1980 19 p refs Prepared in cooperation with George Washington Univ., Washington, D.C.
(Contracts N00014-76-C-0723; N00014-77-C-0263; Grant DAAG29-80-C-0067; NR Proj. 047-204; NR Proj. 042-372)
(AD-A092983; SC5065.5TR) Avail: NTIS HC A02/MF A01 CSCL 14/2

This is an expository survey of the various procedures used in life testing, including those used in accelerated life testing. This survey was written at the invitation of Professors N.L. Johnson and S. Kotz, editors of the forthcoming Encyclopedia of Statistical Sciences, to be published by John Wiley and Sons, Inc., New York. GRA

N81-17472# California Univ., Davis. Intercollege Div. of Statistics.
STATISTICAL INFERENCE FOR A NEW MODEL IN RELIABILITY Interim Report
Ronald G. Glaser Aug. 1980 22 p refs
(Grant AF-AFOSR-3180-77; AF Proj. 2404)
(AD-A093147; TR-16; AFOSR-80-1162TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A new family of life models proposed by Glaser (1980) has densities. The family includes all gamma distributions, all exponential distributions, all normal distributions left truncated at zero, and a variety of distributions having bathtub shaped failure rate functions. In this paper statistical inference for the family is considered with an emphasis on determining whether the sampled model fits the bathtub category. GRA

N81-17473# Cornell Univ., Ithaca, N. Y. Dept. of Theoretical and Applied Mechanics.
ULTRASONIC NON-DESTRUCTIVE TESTING OF MATERIALS ISOLATION OF PRINTED CIRCUIT BOARDS Interim Report, 1 Aug. 1978 - 31 Jul. 1980
Wolfgang Sachse and Vih-Hsing Peo Dec. 1980 26 p
(Contract F49620-78-C-0100; AF Proj. 2307)
(AD-A093812; AFOSR-80-1366TR; IR-2) Avail: NTIS HC A03/MF A01 CSCL 11/4

This report describes broadband measurements of ultrasonic dispersion and attenuation in cross-plied specimens of graphite-epoxy. Quantitative comparisons of dispersion and attenuation data are made by means of least-square fit algorithms implemented into the ultrasonic signal processing system. Reproducible measurements in graphite-epoxy have been obtained. Two new frequency-dependent attenuation measurement techniques are described for measurements in composite materials. One is a continuous-wave resonance technique and the other is based on the Kramers-Kronig relation to find the attenuation from measurement of the dispersion. The new techniques are expected to be especially useful for measurements in highly absorbent composite specimens. A firm basis for the technique has been established and measurements with graphite-epoxy specimens are described. Good agreement can be obtained between the various attenuation measurement techniques. GRA

N81-17474# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Statistics.
ADAPTIVE DESIGNS IN ATTRIBUTE LIFE TESTING
Mohammad Kazim Khan and S. Zacks 15 Sep. 1980 26 p refs
(Contract N00014-80-C-0325; NR Proj. 042-276)
(AD-A093510; VPI-TR-3) Avail: NTIS HC A03/MF A01 CSCL 12/1

The study is concerned with the problem of adaptively determining the (surveillance) observation epochs for the purpose of estimating the parameter(s) of a life distribution under attribute life testing. A discrete adaptive procedure is developed and proved to be epsilon-optimal under the criterion of maximizing the Fisher information function. GRA

N81-17475# Wisconsin Univ. - Madison. Mathematics Research Center.
A NOTE ON A DIFFICULTY INHERENT IN ESTIMATING RELIABILITY FROM STRESS-STRENGTH RELATIONSHIPS
Bernard Harris and Andrew P. Soms Oct. 1980 12 p refs
(Contracts DAAG29-80-C-0041; N00014-79-C-0321)
(AD-A093637; MRC-TSR-2123) Avail: NTIS HC A02/MF A01 CSCL 20/11

This note calls attention to a difficulty which arises frequently in the application of stress-strength methods in reliability theory. This difficulty has led to unanticipated catastrophic failures in a number of applications. GRA

N81-17476# Battelle Columbus Labs., Ohio.
FEASIBILITY EVALUATION OF ADVANCED MULTIFREQUENCY EDDY CURRENT TECHNOLOGY FOR USE IN NAVAL AIR MAINTENANCE ENVIRONMENT Final Report, 25 Oct. 1978 - 23 Jul. 1979
Donald T. Hayford and Stephen D. Brown 8 Dec. 1980 80 p
(Contract N68335-78-C-1121)
(AD-A093314; NAEC-92-143) Avail: NTIS HC A05/MF A01 CSCL 14/2

The optimization of a multifrequency eddy current test was performed for the detection and characterization of second-number corrosion using computer programs. The results of the analytical studies showed that both inner and outer surface corrosion could be detected and quantified. Air gap variations could also be distinguished from corrosion using multifrequency data. These results were confirmed experimentally using phase-sensitive eddy current instrumentation. GRA

N81-17477# Florida State Univ., Tallahassee. Dept. of Statistics.
ASSESSMENT OF RELIABILITY FOR REPAIRABLE SYSTEMS Final Report, 1 Jul. 1979 - 30 Sep. 1980
Mark Brown Nov. 1980 12 p
(Contract F49620-79-C-0157; AF Proj. 2304)
(AD-A093377; FSU-STATISTICS-M563; AFOSR-80-1341TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Define Z(t) to be the forward recurrence time at t for a renewal process with interarrival time distribution, F, which is assumed to be IMRL (increasing mean residual life). It is shown that Ephi(Z(t)) is increasing in t - 0 for all increasing convex 0. An example demonstrates that Z(t) is not necessarily stochastically increasing nor is the renewal function necessarily concave. Both

of these properties are known to hold for F DFR (decreasing failure rate). GRA

N81-17478# Bendix Corp., Kanses City, Mo.
IMPROVING WELD QUALITY WITH LASER MONITORING
M. K. Burris Oct. 1980 20 p
(Contract DE-AC04-76DP-00613)
(BDX-613-2497) Avail: NTIS HC A02/MF A01

A carbon dioxide laser beam monitoring system was developed to enhance the quality of a weld by monitoring equipment parameters affecting the weld. Investigative efforts resulted in the characterization of a laser beam by specially designed monitor assemblies, data collection by a newly developed data acquisition system, and data analysis by computer interface with the data acquisition system. DOE

N81-17479# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
QUALITATIVE AND QUANTITATIVE RELIABILITY ANALYSIS OF SAFETY SYSTEMS
R. Karimi, N. Rasmussin, and L. Wolf May 1980 288 p refs
Sponsored in part by Boston Edison Co., Mass.
(PB81-118325; MIT-EL-80-015) Avail: NTIS HC A13/MF A01 CSCL 14D

A code was developed for the comprehensive analysis of a fault tree. The code designated UNRAC (UNReliability Analysis Code) calculates the following characteristics of an input fault tree: (1) minimal cut sets; (2) top event unavailability as point estimate and/or in time dependent form; (3) quantitative importance of each component involved; and (4) error bound on the top event unavailability. Overall it is demonstrated that UNRAC is an efficient, easy to use code and has the advantage of being able to do a complete fault tree analysis with this single code. Applications of fault tree analysis to safety studies of nuclear reactors are considered. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N81-17480*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPOSITE CONTAINMENT SYSTEMS FOR JET ENGINE FAN BLADES
G. T. Smith 1981 18 p refs Presented at the 36th Ann. Conf. of the Reinforced Plastics/Composites Inst. of the Soc. of the Plastics Ind., Inc., Washington, D.C., 16-20 Feb. 1981
(NASA-TM-81675; E-700) Avail: NTIS HC A02/MF A01 CSCL 21E

The use of composites in fan blade containment systems is investigated and the associated structural benefits of the composite system design are identified. Two basic types of containment structures were investigated. The short finned concept was evaluated using Kevlar/epoxy laminates for fins which were mounted in a 6061 T-6 aluminum ring. The long fin concept was evaluated with Kevlar/epoxy, 6Al4V titanium, and 2024 T-3 aluminum fins. The unfinned configurations consisted of the base-line steel sheet, a circumferentially oriented aluminum honeycomb, and a Kevlar cloth filled ring. Results obtained show that a substantial reduction in the fan blade containment system weight is possible. Minimization of damage within the engine arising from impact interaction between blade debris and the engine structure is also achieved. M.G.

N81-17481# Nagoya Univ. (Japan). Inst. of Plasma Physics.
STRESS FIELDS AROUND A CRACK LYING PARALLEL TO A FREE SURFACE
Y. Higashida (Maiko Senior High School, Japan) and K. Kamada Dec. 1980 43 p refs
(IPPJ-493) Avail: NTIS HC A03/MF A01

A method of stress analysis for a two dimensional crack, which is subjected to internal gas pressure, is presented. It is based on the concept of continuously distributed edge dislocations of two kinds: one with Burgers vector normal to the free surface and the other with parallel to it. Stress fields of individual dislocations were chosen so as to satisfy stress free boundary conditions at the free surface, by taking account of image dislocations. Distributions of the both kinds of dislocations in the crack were derived so as to give the internal gas pressure and, at the same time, to satisfy shear stress free boundary condition on the crack surface. Stress fields in the subsurface layer was then determined from them. They have square root singularities at the crack tip. T.M.

N81-17482*# Boeing Aerospace Co., Kent, Wash.
DESIGN DATA FOR BRAZED RENE 41 HONEYCOMB SANDWICH Final Report
Andrew K. Hepler, John Arnquist, Edward L. Koetje, John J. Esposito, Victor E. J. Lindsay, and Allan R. Swegle Jan. 1981 143 p refs
(Contract NAS1-14213)
(NASA-CR-3382; D180-26187-1) Avail: NTIS HC A07/MF A01 CSCL 20K

Strength data, creep data and residual strength data after cyclic thermal exposure were obtained at temperatures from 78 K to 1144 K (-320 F to 1600 F). The influences of face thickness, core depth, core gage, cell size and thermal/stress exposure conditions on the mechanical design properties were investigated. A braze alloy and process was developed that is adequate to fully develop the strength of the honeycomb core while simultaneously solution treating and aging the Rene 41 fact sheets. New test procedures and test specimen configurations were developed to avoid excessive thermal stresses during cyclic thermal exposure. A.R.H.

N81-17483# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Flugzeuge.
THE INFLUENCE OF THE COMPRESSIBILITY IN SIMULATING THE CONDUCT OF EXTERIOR LOADS OF A CARRIER [DER EINFLUSS DER KOMPRESSIBILITAET ZUR SIMULATION DES ABGANGSVERHALTENS VON AUSSENLASTEN VOM TRAEGER]
K. Thomas 26 Nov. 1979 21 p refs In GERMAN Presented at DGLR Wehrtech. Symp. on der Abgang von Lasten und Waffen vom Traeger, Bad Neuenahr, West Germany, 26-27 Nov. 1979
(MBB-FE-122/S/PUB/17; DGLR-79-094) Avail: NTIS HC A02/MF A01

The panel method was used in the computation of the flow field of an aircraft, the pressure distribution on the upper surface, and the aerodynamic loads. With this method the effect of compressibility on pressure distribution can be relatively well understood when Gothert's Rule is applied. However, this rule is not applicable on the flow field of the aircraft. A flow field model was developed based on Gothert's Rule and the panel method, in order to obtain an appropriate solution for compressibility effects. Results from the computations on the flow field model are presented. Transl. by E.A.K.

N81-17484# Stuttgart Univ. (West Germany). Inst. Fuer Statik und Dynamik.
INELASTIC BEHAVIOR OF PLASTIC MATERIALS [INELASTISCHES VERHALTEN VON KUNSTSTOFFEN]
J. H. Argyris, G. Faust, J. Szimmat, and K. J. William Dec. 1979 67 p refs In GERMAN
(Contract DFG-AR-44/46)
(ISD-267; ISSN-0170-6071) Avail: NTIS HC A04/MF A01

Theoretical determination of the inflexibility of man made construction materials developed for use in the air and space industries is described. An overview of the available data is given and research goals are summarized. Transl. by E.A.K.

N81-17485# Kentucky Univ., Lexington. Coll. of Engineering.
FLOW LEADING TO FRACTURE Final Report
P. P. Gillis and S. E. Jones Oct. 1980 9 p refs
(Grant AF-AFOSR-3379-77; AF Proj. 2307)
(AD-A093129; AFOSR-80-1286TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

Activity on the project was sharply focused on the principal research objectives; to establish a theoretical basis for the forming limit diagram. Formidable algebraic difficulties impeded this

effort and it was not until the end of the second year that the first satisfactory theoretical development was completed. This theory accounts for biaxial stretching which comprises the right half of the forming limit diagram, and accounts for the effects of strain rate sensitivity on material behavior. However, it cannot be applied to the left half of the diagram (longitudinal stretching with transverse contraction) in any direct way. So much work remains to be done in the basic theoretical formulation. Numerical results calculated on the basis of the above theory were not entirely satisfactory. This led to an examination of the material flow law being used and this law was shown to have certain fundamental defects. Reformulation of the flow law led to preparation of a manuscript entitled 'A Generalized Quadratic Flow Law for Sheet Metals'. Numerical results calculated on the basis of the above theory incorporating the reformulated flow law are quite satisfactory. They are being incorporated in a manuscript entitled 'Biaxial Stretching of a Flat Sheet. GRA

N81-17486# Pittsburgh Univ., Pa. School of Engineering.
SCIENCE OF FRACTURE Annual Report, 15 Aug. 1979 - 30 Sep. 1980
M. L. Williams and C. C. Yates 22 Oct. 1980 262 p refs
(Contract F49620-78-C-0101; AF Proj. 2307)
(AD-A093417; SETEC-SF-80-048; AFOSR-80-1322TR) Avail: NTIS HC A12/MF A01 CSCL 20/11

This research program is intended to explore and develop commonalities in fracture theory as applied to wide classes of differing materials at different scales - from the atomic to the continuum. Primary attention is focused upon analytical and experimental methods needed to analyze underlying and potentially common basic mechanisms controlling the fracture process, e.g. two and three dimensional stress singularities, effect of environment, etc. and to examine structure-property relationships, including the effect of the fabrication process upon the preparation of specimens made from standardized model materials representative of polymers and metals. Major results during this year include additional analysis and development of a cracked Brazil specimen for deducing Mode 2 fracture toughness, further parametric analysis of the effect of geometry in an embedded fiber or rod and the location of initial interfacial debonding from the matrix upon resulting adhesive fracture under load, determination that initial phase of fracture in a cobalt-nickel alloy (MP 35) is probably void nucleation caused by grain boundary sliding during dynamic recrystallization, plasma activated sintering can product apparently clean, active particle surfaces in silicon carbide powders, and that it is realistic to plan generating two standard reproducible materials one epoxy resin and one linear viscoelastic polymer -which can be used to relate chemical structure to mechanical properties. GRA

N81-17487# Florida State Univ., Tallahassee. Dept. of Statistics.
SHOCK MODELS ARISING FROM PROCESSES WITH STATIONARY INDEPENDENT, NONNEGATIVE INCREMENTS Interim Report
Harry Joe and Frank Proschan Oct. 1980 16 p refs
(Grant AF-AFOSR-3678-78; AF Proj. 2304)
(AD-A093127; FSU-STATISTICS-M557; AFOSR-80-1227TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

Let H(t) be the life distribution of a device subject to shocks governed by an integer-valued stochastic process with stationary, independent, nonnegative increments. H(t) is a function of the probabilities PR of surviving the first k shocks, k = 1, 2, ... We show that H(t) inherits various aging properties (IFR, IFRA, NBU) of the discrete survival function Pk. Analogous results hold in the continuous case where H(t) is the life distribution of a device subject to wear according to a wear process with stationary, independent nonnegative increments. In the cumulative damage model for the wear process or for the shock process, H is IFRA if the process enjoys a TP2 property. GRA

N81-17488# Technion - Israel Inst. of Tech., Haifa. Material Mechanics Lab.
TIME DEPENDENT INELASTIC BEHAVIOR OF MATERIALS Final Scientific Report, 1 Jul. 1979 - 30 Jun. 1980
Sol R. Bodner Jul. 1980 16 p refs
(Contract F49620-79-C-0196; AF Proj. 2307)
(AD-A093121; MML-70; AFOSR-80-1314TR) Avail: NTIS HC A02/MF A01 CSCL 11/7

A principal subject of the research program was the development of the anisotropic hardening theory of Stouffer and Bodner for elastic-viscoplastic materials into a practical computational tool. This has been achieved and demonstrated for problems of the dynamic impact of indenters into slabs of the reference material, which experience induced plastic anisotropy. Another development has been the application of the elastic-viscoplastic constitutive equations with isotropic hardening to problems involving laminated materials. The equations have also been used as the basis to examine the response of metals over a wide range of temperatures and strain rates and as the material model in fracture mechanics problems. GRA

N81-17489# Ballistic Research Labs., Aberdeen Proving Ground, Md.
QUASI-STATIC STRESS-STRAIN CURVES, S-7 TOOL STEEL Final Report
Ralph F. Benck, Robert E. Franz, and Dominick A. Diberardo Oct. 1980 31 p refs
(DA Proj. 1L1-61102-AH-43)
(AD-A093773; AD-E430556; ARBRL-MR-03067) Avail: NTIS HC A03/MF A01 CSCL 11/6

The results of quasi-static, uniaxial, compression, and tensile and sonic elastic moduli room temperature tests of S-7 tool steel are presented. The modulus of elasticity, shear modulus, Poisson's ratio, yield strength, and bulk modulus of various tempers of S-7 tool steel are reported as well as the stress-strain curves for both compression and tensile loading. GRA

N81-17490# Brown Univ., Providence, R. I. Div. of Engineering.
PREDICTION OF CREEP OF AL 2618 UNDER VARIABLE MULTIAXIAL STRESSES Final Technical Report, 20 Sep. 1979 - 19 Sep. 1980
William N. Findley 3 Dec. 1980 7 p
(Grant DAAG29-70-G-0185)
(AD-A093697; ARO-15508.4-E) Avail: NTIS HC A02/MF A01 CSCL 11/6

Simultaneous creep in torsion and stress relaxation in tension experiments with proportional and non-proportional load changes were reasonably predicted by a modified viscous-viscoelastic model. Creep experiments at stresses below a transition stress showed linear behavior with no synergistic effect. Above the transition, creep was non-linear and synergistic. Stress reversal at low stresses showed the same time dependence for both positive and negative stressing, but prior creep was not wiped out. At higher stresses prior creep was wiped out on complete reversal of stress. GRA

N81-17491# Naval Research Lab., Washington, D. C.
FATIGUE AND FRACTURE RESISTANCE OF STAINLESS STEEL WELD DEPOSITS AFTER ELEVATED-TEMPERATURE IRRADIATION Interim Report
J. R. Hawthorne 18 Nov. 1980 20 p refs
(AD-A093090; NRL-8451) Avail: NTIS HC A02/MF A01 CSCL 11/6

The fatigue crack growth and fracture resistance of Type 308-16 austenitic stainless steel weld deposits were investigated for 427 and 649 C neutron irradiation conditions. The welds (63.5 mm thick) were made by the shielded metal arc process and depicted variations in delta ferrite content from ferrite number 5.2 to 19.0. Specimen irradiations were conducted in the EBR-II reactor in flowing and static sodium environments. Fatigue crack growth resistances at 427 and 649 C were determined with single-edge-notch (SEN) cantilever fatigue specimens tested in air with a zero-tension-zero loading cycle. Crack growth rates were related to the stress-intensity-factor range. Effects of a tension hold time of 0.5 minute were explored relative to weld behavior under continuous load cycling conditions. Fracture resistance at elevated temperature was investigated through notch ductility and dynamic fracture toughness determinations by Charpy-V and fatigue-precracked Charpy-V test methods respectively. GRA

N81-17492# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
MODELLING OF DEFORMATION AND FRACTURE IN

HIGH-TEMPERATURE STRUCTURAL MATERIALS, PART 1 Annual Progress Report, 1 Apr. 1979 - 31 Mar. 1980
Alan K. Miller and Oleg D. Sherby Apr. 1980 52 p refs
(Contract DE-AT03-76ER-70057)
(SU-DMS-80-R-2-Pt-1) Avail: NTIS HC A04/MF A01

Three major areas of strengthening mechanisms were investigated: solute strengthening (and other mechanisms which do not depend on work hardening); isotropic work hardening; and directional work hardening. Equations containing variables which represent these areas were developed as quantitative methods of analysis. These methods can be used to predict deformation and fracture of metals and alloys under the complex histories and environments which are typical of energy related systems. T.M.

N81-17493# Wisconsin Univ. - Madison. Fusion Engineering Program.
PREDICTION OF THE BEHAVIOR OF STRUCTURAL MATERIALS UNDER IRRADIATION THROUGH MODELING OF THE MICROSTRUCTURE Progress Report, 30 Aug. - 1 Nov. 1980
W. G. Wolfer Sep. 1980 7 p refs
(Contracts DE-AS02-78ER-04861; ER-78-02-4861)
(COO-4861-2) Avail: NTIS HC A02/MF A01

A general formulation was completed to derive the irradiation creep rate in single crystals. An investigation was initiated and completed on the capture efficiencies of interstitial type and vacancy type loop. A nucleation theory for vacancy loops was developed, and the conditions with regard to displacement rate, irradiation temperature, and microstructure were established for vacancy type loops to nucleate. An equation of state for gaseous helium was developed, which can be applied regardless of the gas pressure or temperature. Comparison of the developed equation of state with experimental data gave results to within 3 percent. The equation of state for gaseous helium was applied to equilibrium gas bubbles in solids. A preliminary experiment with an eccentric pressurized tube, suspended vertically in a furnace, was carried out until earlier brittle creep rupture occurred. DOE

N81-17494# Sandia Labs., Albuquerque, N. Mex.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE ELASTIC AND PLASTIC BEHAVIOR OF PLATES ON FOUNDATIONS SUBJECTED TO DYNAMIC PUNCH LOADING
T. A. Duffey, S. H. Sutherland, and M. Cheresh (Effects Technology, Inc.) 1980 7 p refs Presented at the 8th Canadian Cong. of Appl. Mech., Moncton, Canada, 7 Jun. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-2484C; CONF-8006134-1) Avail: NTIS HC A02/MF A01

Analytical solutions and experimental results are presented for the response of foundation backed plates to static and dynamic punch loading. Tests were performed on polyurethane foam backed and unbacked plates; plates were centrally loaded over a range in plastic deformations up to complete failure. An attempt was made to understand the puncture resistance of the sidewalls of containers used to ship hazardous wastes. DOE

N81-17495# Centre Technique des Industries Mecaniques, Senlis (France).
STRUCTURAL RESPONSE TO TRANSIENT LOADS Final Report [REPONSE DES STRUCTURES A SES EXCITATIONS TRANSITOIRES]
P. Lepert 16 Feb. 1979 219 p In FRENCH
(CETIM-15-E-08-0) Avail: NTIS HC A10/MF A01

Two computer programs are presented, one for calculation directly by integration, and the other for integration of the response in the base mode of the structure after truncation beyond a certain frequency. The field of application of these programs is analyzed. Special emphasis is given to the possibility of introducing non-zero initial conditions into the programs and to the possibility of imposing displacements as a function of time on certain lattice crossings in the structure. It is shown that less memory is needed for the base mode approach and that in most cases integration by this program is sufficient. Author (ESA)

N81-17496# Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e. V., Darmstadt (West Germany). Lab. fuer Betriebsfestigkeit.
EXAMINATION OF FATIGUE BEHAVIOR IN COMPOSITE STRUCTURES UNDER LOAD [SCHWINGFESTIGKEITSUNTERSUCHUNGEN AN FUEGUNGEN IN FASERBAUWEISE]
J. J. Gerharz, D. Rott, and D. Schuetz Bonn Bundesministerium fuer Verteididung 1979 91 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteididung (BMVg-FBWT-79-23) Avail: NTIS HC A05/MF A01; DOKZENTBW, Bonn DM 30

To provide design data for graphite/epoxy composite structures, stress-strain behavior during monotonic loading, fatigue behavior, and deformation behavior during cyclic loading of composite bolted joints were investigated to provide design data for graphite/epoxy composite structures. The laminate structure of the jointed composite plates was tuned to load conditions in aircraft fuselage skins. Results show that the stress strain behavior of the composite composite joints is extensively nonlinear under increasing tensile or compressive loads. The fatigue behavior of the composite joints, during constant amplitude loading with the stress ratio at 1.66, shows the deepest drop in fatigue strength as to static strength. In the low cycle region, the negative influence of the stress concentration is largest, decreasing more and more with decreasing stress levels until it has vanished in the fatigue limit region. Increase in the deformation of the joints during fatigue loading is not porportional to the number of load cycles. Author (ESA)

N81-17497# Societe Nationale Industrielle Aerospatiale, Paris (France).
EXPERIMENTAL METHODOLOGY AND APPLICATION OF FRACTURE MECHANICS TO METALS [METHODOLOGIE EXPERIMENTALE ET APPLICATION DES CONCEPTS DE MECANIQUE DE LA RUPTURE AUX METAUX]
J. Odorico Association Aeronautique et Astronautique de France 1979 22 p In FRENCH Presented at 14th AAAF Intern. Aeron. Congr. Paris, 6-8 Jun. 1979
(AAAF-NT-79-35; ISBN-2-7170-0583-8) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

A fracture mechanics approach to metal fatigue and stress corrosion cracking in samples undergoing test to ruin is illustrated. Results are intended to improve the choice of materials used in metallic constructions for aeronautics and to enhance in service behavior predictions for these structures. Fatigue and/or corrosion parameters are classed in three categories: fault appearance thresholds; crack propagation laws; and catastrophic rupture parameters. Various test schemes to elucidate these categories are depicted and discussed. Author (ESA)

N81-17498# Centre National d'Etudes Spatiales, Paris (France).
THE USE OF FRACTURE MECHANICS STUDIES AS PART OF THE ARIANE SPACE PROGRAM [UTILISATION DES ETUDES DE MECANIQUE DE LA FRACTURE DANS LE PROGRAMME ARIANE]
J. P. Ledey and N. Hrisafovic (SNIAS, Les Mureaux, France) Association Aeronautique et Astronautique de France 1979 20 p In FRENCH
(AAAF-NT-79-36; ISBN-2-7170-0584-6) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 22 (France and EEC) FF 27 (others)

Application of fracture mechanics in the design, dimensioning, and testing of pressure vessels is discussed. Given the materials and welding techniques used in the construction of thin walled fuel tanks in the second stage of the ARIANE rocket vehicle, the tank integrity test program is cited as an example. Based on test to failure results and a comparison with the effects of initial crack propagation on these results as foreseen through fracture mechanics, a scheme for setting an appropriate test pressure coefficient for these structures is justified. Author (ESA)

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N81-17499* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

METHOD FOR OBSERVING THE FEATURES CHARACTERIZING THE SURFACE OF A LAND MASS Patent

Robert D. Reed, inventor (to NASA) Issued 23 Dec. 1980 7 p Filed 30 May 1979 Supersedes N79-24979 (17 - 16, p 2073)

(NASA-Case-FRC-11013-1; US-Patent-4,240,601; US-Patent-Appl-SN-043912; US-Patent-Class-244-160; US-Patent-Class-244-49) Avail: US Patent and Trademark Office CSCL 08B

A method is described where a propeller driven, hydrazine powered aircraft is remotely piloted through rarefied atmosphere of a selected planet, including the planet Earth. It is employed as a communication platform for a telemetry system provided for relaying information relating to features characterizing the surface of the planet.

Official Gazette of the U.S. Patent and Trademark Office

N81-17500# Defense Mapping Agency Aerospace Center, St. Louis, Mo. Advanced Technology Div.

INCREASED SENSOR SIMULATION CAPABILITY AS A RESULT OF IMPROVEMENTS TO THE DIGITAL LANDMASS SYSTEM (DLMS) DATA BASE Interim Report, May 1979 - Sep. 1980

Marshall B. Faintich and John Gough Sep. 1980 23 p refs Proposed for Presentation at the Image 2 Conf., Williams AFB, Ariz., 10-12 Jun. 1981

(AD-A093120) Avail: NTIS HC A02/MF A01 CSCL 09/2

The Defense Mapping Agency is producing digital culture and terrain elevation data bases to support advanced aircraft simulators. Data base analyses and sensor simulations have led to improvements in specifications for these data bases and have been used to define parameters to be included in a prototype data base designed to support visual and other high resolution sensors. These improvements and new parameters are discussed and sensor simulations and data base displays are shown. GRA

N81-17501# Institute for Research, State College, Pa.

CONCEPT VALIDATION COMBINED DEVELOPMENT TEST AND EVALUATION/OPERATIONAL EVALUATION OF THE COMPASS PREVIEW TEST BED (CPTB) SYSTEM Final Technical Report, Feb. 1978 - May 1980

Paul C. Harrison Griffiss AFB, N.Y. RADC Nov. 1980 85 p (Contract F30602-78-C-0072; AF Proj. 2165)

(AD-A093498; RADC-TR-80-346) Avail: NTIS HC A05/MF A01 CSCL 15/4

This document establishes a plan for the government conducted test of the Compass Preview Test Bed (CPTB) System. The test plan establishes the background and purpose of the test, the method of accomplishment, and general procedures for preparing and reviewing test reports. A six part annex establishes a plan for evaluating operational suitability and system software. A data management plan is also established for receipt, validation, reduction, retention, processing, and analysis of all data collected during the test. AFM 55-43 was used as a guide in establishing the format of this test plan. GRA

N81-17502# Oak Ridge National Lab., Tenn. Chemistry Div.

CHEMICALS FOR ENHANCED OIL RECOVERY Quarterly Report, 1 Oct. - 31 Dec. 1980

James S. Johnson, Jr., A. L. Compere, S. V. Greene, W. L. Griffith, K. Harshman, R. M. Jones, L. J. Magid, R. Triolo, C. G. Westmoreland, and J. M. Crenshaw Oct. 1980 45 p refs (Contract W-7405-eng-26)

(DOE/BETC-OR-15) Avail: NTIS HC A03/MF A01

Studies on the salinity range in which three liquid phases are observed for systems containing a tall oil ethoxylate or related nonionic surfactant, a cosurfactant, aqueous NaCl, and a hydrocarbon were extended. Increasing hydrophile-lipophile balance, HLB, causes an increase in the salinity needed to effect the transition of the surfactant from the lower to the upper phase. However, other factors besides HLB seem to be involved. Addition of the nonionic surfactant increases optimal salinity by an amount which depends on its hydrophilic character. Sodium-2-methyloleate,-2-butyloleate, -2-hexyloleate, -2,2-dimethyloleate, and -2,2-diethyloleate were synthesized and its phase behavior in aqueous/hydrocarbon systems studied. Adsorption of a commerical petroleum sulfonate from 0.1 M NaCl on the sodium form of montmorillonite was reduced a factor of ten by caustic extract from bleaching of wood pulp. DOE

N81-17503# Geological Survey, Reston, Va.

UNITED STATES GEOLOGICAL SURVEY OF SOURCES OF PHOTOGRAPHS AND IMAGES OF BIOSPHERE RESERVES TAKEN FROM SPACECRAFT AND AIRCRAFT: FRASER EXPERIMENTAL FOREST

Marrianne Moskowitz 1980 78 p refs

(PB80-224033) Avail: NTIS HC A05/MF A01 CSCL 08B

A listing is given of remotely sensed data gathered from spacecraft and aircraft available for the Fraser Experimental Forest. The listed material is available tographic form and, in the case of LANDSAT images, computer compatible magnetic tapes. GRA

N81-17504# Colorado State Univ., Fort Collins. Dept. of Earth Resources.

A WATERSHED INFORMATION SYSTEM Ph.D. Thesis

Anton G. Thomsen 1980 177 p refs (OWRT Proj. B-160-COLO(3))

(PB81-115701; W81-00081; OWRT-B-160-COLO(3)) Avail: NTIS HC A09/MF A01 CSCL 08H

An information system for the analysis and simulation of mountain watersheds is described. Data on topography, vegetation and soils in digital terrain models (overlays) serve as the data base for watershed analysis classification of snow in LANDSAT imagery and automatic generation of parameter decks for operating distributed simulation models of snowvover dynamics and steamflow generation. The computer programs that generate the parameter decks have built in calibration options for all major processes. Snow processes are simulated within square grid cell elements. The hydrograph resulting from spring snowmelt is simulated by a lateral flow model of streamflow generation driven by the simulated spatially distributed input (snowmelt and rain). Options are available for simulating the effects of forest management alternatives (thinning, clearcutting) on selected forest stands. GRA

N81-17505# Wisconsin Univ. - Madison. Water Resources Center.

SOURCES AND EFFECTS OF COLOR IN THE WISCONSIN RIVER, WISCONSIN

Christine Mechenich, Byron H. Shaw, and Theodore S. Roeder 1980 62 p refs (Contracts DI-14-34-0001-8053; DI-14-34-0001-9053; OWRT Proj. A-080-WIS)

(PB81-113342; WIS/WRC-80-09; OWRT-A-080-WIS(1)) Avail: NTIS HC A04/MF A01 CSCL 08H

Wastewater discharges from the pulp and paper industry, especially during periods of low flow, influence the color of the Wisconsin River. The effect of color and associated effects of light penetration on the growth of algae in Lake Du Bay were investigated. Carbon assimilation rates increased as water color decreased, except for occasional instances of surface inhibition. Changes in carbon assimilation rates varied with depth. Multiple regression analysis indicated that red light penetration was the most significant predictor of carbon assimilation rate changes. The contribution of industry to true and apparent color of the

Wisconsin River appears to lower algal productivity in reservoirs. GRA

N81-17506# Environmental Monitoring and Support Lab., Las Vegas, Nev.
REMOTE SENSING OF OZONE USING AN INFRARED DIFFERENTIAL ABSORPTION SYSTEM Technical Report, 1978
J. L. Guagliardo, R. T. Thompson, Jr., D. H. Bundy, and M. H. Wells (Nevada Power Co., Las Vegas) Nov. 1980 14 p refs (PB81-111866; EPA-600/4-80-047) Avail: NTIS HC A02/MF A01 CSCL 14B

A prototype airborne downlooking infrared differential absorption system using CO2 TEA (transverse excited atmospheric) lasers is described. The system uses two wavelengths and topographic reflection to measure the integrated column concentration of ozone between the laser source/receiver and a noncooperative target. A comparison is made between ozone absorption coefficients measured with TEA lasers and values reported from other sources. Ground tests utilized two 30-cm long ozone-filled test cells, one in each laser path. A correlation was observed between measurements of TES laser pulses backscattered from a building and ultraviolet determination of ozone concentration in the cells. GRA

N81-17507# Forest Service, Washington, D. C.
AN APPROACH TO WATER RESOURCES EVALUATION OF NON-POINT SILVICULTURAL SOURCES. (A PROCEDURAL HANDBOOK) Final Report, Dec. 1976 - Dec. 1979
Aug. 1980 847 p refs
(PB81-119828; EPA-600/8-80-012) Avail: NTIS HC A99/MF A01 CSCL 02F

This handbook provides an analysis methodology that can be used to describe and evaluate changes to the water resource resulting from nonpoint silvicultural activities. This approach for analysis and prediction of pollution from non-point silvicultural activities is a rational estimation procedure that is useful in making comparative analyses of management alternatives. Quantitative techniques are provided for estimating potential changes in stream flow, surface erosion, soil mass movement, total potential sediment discharge, and temperature. Qualitative discussions of the impacts of silvicultural activities on dissolved oxygen, organic matter, nutrients, and introduced chemicals are included. GRA

N81-17508# Geological Survey, St. Paul, Minn. Water Resources Div.
WATER QUALITY OF FOUR LAKES IN LAKEVILLE, MINNESOTA Water-resources investigations.
Lan H. Tomes and Mark R. Have Jul. 1980 59 p refs Prepared in cooperation with City of Lakeville, Minn.
(PB81-119943; USGS/WRD-WRI-80/071; USGS/WRI-80-66) Avail: NTIS HC A04/MF A01 CSCL 08H

Water quality characteristics were determined for four selected lakes to provide background data for evaluating changes that occur in the lakes because of urbanization. Precipitation of calcium carbonate is suggested by high pH values and a decrease in the calcium concentration when magnesium, sodium, and chloride concentrations increase. Pollution is indicated by chloride concentrations. The eutrophic state of the lakes is suggested by dissolved oxygen supersaturated near the surface and less than 0.1 milligram per liter near the deepest parts of the lakes. Determination of the trophic state of the lakes provided trophic state indices as high as 69.2. Phytoplankton blooms occurred throughout the year. GRA

N81-17509# New Mexico State Univ., Las Cruces.
A GEOCHEMICAL AND HYDROLOGICAL INVESTIGATION OF GROUNDWATER RECHARGE IN THE ROSWELL BASIN OF NEW MEXICO: SUMMARY OF RESULTS AND DETERMINATIONS
Gerardo Wolfgang Gross and Roberta N. Hoy Apr. 1980 149 p refs Sponsored by Interior Dept.
(PB81-114647; WRRI-122; W81-0078; OWRT-A-055-NMEX(4)) Avail: NTIS HC A07/MF A01 CSCL 08H

Isotope determination for tritium, deuterium, and oxygen-18 were made as a function of time and space. Observation well levels, springflow, and precipitation were analyzed by stochastic/numerical approaches. Also, a hydrogeologic survey was made of representative springs in the recharge zone on the basin western flank. An updated listing of tritium activity in precipitation, springs, surface runoff, and subsurface water from over 120 sampling sites in the basin is presented. Substantial deep leakage contributions from the basin western flank must be included to account for the basin groundwater budget. GRA

N81-17510# Institute of Gas Technology, Chicago, Ill.
ASSESSMENT OF METHANE HYDRATES Final Report, Dec. 1978 - Jun. 1980
Maurice I. Scott, Philip L. Randolph, and Jon B. Pangborn Oct. 1980 94 p refs
(Contract GRI-5011-310-0097)
(PB81-113300; GRI-79/0070) Avail: NTIS HC A05/MF A01 CSCL 08G

Prospective geological sites for gas hydrate existence, are identified to be the Arctic permafrost zones and under the ocean in deep desiments. Concentrating on the permafrost zone of Alaska, a computer search of 430 wells identifies those where data was logged that might indicate hydrate interest. Records of one particular well, Northwest Eileen State Number 2, strongly suggest the existence of a major natural gas hydrate deposit. An estimate of gas in place for the area around this well leads to a potential resource of 68 billion cubic feet per square mile. This is five times the amount of gas that would have been present if the depth interval were a conventional gas reservoir at hydrostatic pressure. Developed evidence strongly supports the existence of major quantities of natural gas trapped as hydrate (and possibly trapped below hydrate layers) in various regions of North America. GRA

N81-17511# Manhattan Coll., New York. Environmental Engineering and Science Program.
MATHEMATICAL MODELS OF WATER QUALITY IN LARGE LAKES. PART 1: LAKES HURON AND SAGINAW BAY Final Report
Dominic M. DiToro and Walter F. Matystik, Jr. Jul. 1980 183 p refs
(Grant EPA-R-803030)
(PB81-114217; EPA-600/3-80-056-Pt-1) Avail: NTIS A09/MF A01 CSCL 08H

A mathematical model of the water quality in large lakes, particularly Lake Huron and Saginaw Bay and Lake Erie, was developed which incorporates both phytoplankton and zooplankton as well as phosphorus, nitrogen and silica nutrient forms. Extensive water quality data for Lake Huron and Saginaw Bay was analyzed and statistically reduced. The model was calibrated by comparison of computed results to these data. An exhaustive treatment of the kinetics employed for modeling the eutrophication process is presented. GRA

N81-17512# Colorado Univ. at Boulder. Inst. of Arctic and Alpine Research.
SAN JUAN MOUNTAINS AVALANCHE STUDY: EVALUATION AND PREDICTION OF AVALANCHE HAZARD Final Technical Report, Jul. 1979 - Jul. 1980
Richard L. Armstrong Jul. 1980 23 p refs Sponsored in part by Water and Power Resources Serv.
(PB81-116121; INSTARR-9-01-85-02453) Avail: NTIS HC A02/MF A01 CSCL 08L

The weather, snow and avalanche conditions for the 1979-1980 winter in the Red Mountain Pass area of the San Juan Mountains in southwestern Colorado are summarized. Air temperature, precipitation, and snow structure data were obtained from a sheltered forest clearing site at an elevation of 3400 m. Wind speed and direction were measured at an exposed ridge-top site located above timberline at an elevation of 3759 m. Avalanche activity was monitored by the systematic observation of 214 individual avalanche paths. For the period of November 1979 through April 1980, the total precipitation was 714 mm, the mean air temperature was -5.7 C, and a total of 435 avalanche events were recorded within the study area. GRA

N81-17513# Cornell Univ., Ithaca, N. Y. Dept. of Environmental Engineering.

EVALUATION OF STOCHASTIC STREAMFLOW MODELS FOR DETERMINATION OF MUNICIPAL WATER SUPPLY RELIABILITY Final Report
Jery R. Stedinger Sep. 1980 90 p refs
(Contracts DI-14-34-0001-8034; DI-14-34-0001-9034)
(PB81-112427; W81-00012; OWRT-A-085-NY(3)) Avail: NTIS HC A05/MF A01 CSCL 08H

Work performed to compare and evaluate the efficiency of alternative estimators of the parameters of 2- and 3-parameter lognormal distributions and the correlation among lognormal random variables is summarized. Stochastic streamflow model verification and validation is considered as well as the effects of parameter uncertainty on derived distributions. GRA

N81-17514# Clemson Univ., S.C. Water Resources Research Inst.
WATER DISTRIBUTION AND MOVEMENT IN AN UNSATURATED PIEDMONT SOIL PROFILE
J. T. Ligon, T. V. Wilson, Joe F. Allen, Thomas G. King, and Udai P. Singh Jan. 1980 112 p refs
(Contract DI-14-31-0001-5041)
(PB81-113995; WRRI-82; W81-00042; OWRT-A-023-SC(9)) Avail: NTIS HC A06/MF A01 CSCL 08H

The deep seepage, groundwater recharge phenomenon was investigated, models of the deep seepage process were developed and moisture displacement in the profile as it relates to the transport of pollutants from the soil surface downward to the groundwater was examined. Field investigations included soil moisture and water table measurements, observations of surface runoff and interflow, and a radioactive tracer study. Two computer programs were written using the IBM simulation language CSMP. In the root zone model, precipitation and temperature data were used to estimate runoff, evapotranspiration and storage in the root zone. Any excess moisture is considered to percolate below the root zone as deep seepage. The second program, called the Deep Seepage model, uses the deep seepage calculated in the root zone model and simulates its movement through the unsaturated zone to the pheatic surface, at a depth of 20m. GRA

N81-17515# Colorado State Univ., Fort Collins. Dept. of Earth Resources.
APPLICATIONS OF REMOTE SENSING IN HYDROLOGY
Diana Claire Fitz 1980 143 p refs
(PB81-111932; W81-00082; OWRT-B-160-COLO(2)) Avail: NTIS HC A07/MF A01 CSCL 08H

Potential applications of remote sensing in the field of hydrology are summarized. An introduction to remote sensing, the physical principles of electromagnetic energy and many of the available sensors are included. Operational uses and research applications of remote sensing in areas related to watershed management are summarized. GRA

N81-17516# Rice Univ., Houston, Tex.
MAXIMUM UTILIZATION OF WATER RESOURCES IN A PLANNED COMMUNITY: CONTRIBUTIONS OF REFRACTORY COMPOUNDS BY A DEVELOPING COMMUNITY Final Report, Sep. 1973 - Dec. 1976
F. M. Fisher Aug. 1980 82 p refs
(Grant EPA-802433)
(PB81-112880; EPA-600/2-80-113) Avail: NTIS HC A05/MF A01 CSCL 08H

Water, soil and biotic components from a natural drainage system were assayed for halogenated compounds. The highest residue values were coincident with the period of development when cut and fill operations, roadbed construction, and service installation were being effected. Mirex and chlordane were found in soil, water, and organisms from the drainage system around the gold course. Compounds in mosquitofish collected from the same area were observed. Both compounds entered lakes by storm water and/or washed in by returning irrigation water from the golf course. Organisms from a stream which received storm waters from the lakes contained less insecticide than the golf course sampling. GRA

N81-17517# Geological Survey, Trenton, N. J. Water Resources Div.
DIGITAL-SIMULATION AND PROJECTION OF HEAD CHANGES IN THE POTOMAC-RARITAN-MAGOTHY ACQUIFER SYSTEM, COASTAL PLAIN, NEW JERSEY Final Report of Water-Resources Investigation
James E. Luzier Jun. 1980 81 p refs Prepared in cooperation with N.J. Dept. of Environmental Protection
(PB81-115768; USGS/WRD/WRI-80/061; USGS/WRI-80-11) Avail: NTIS HC A05/MF A01 CSCL 08H

A digital model was used to simulate the response of the Potomac-Raritan-Magothy aquifer system to pumping stresses. The model was used to compute projected potentiometric heads and trends. Three sets of conditions were simulated: (1) no increase in ground water extractions; (2) continued growth in ground water extractions at the rate of 3 percent annually; and (3) continued growth in ground water extractions at the rate of 3 percent annually. Under the first set of conditions, further head reduction would cease over very large regions within two years. Under the second set of conditions, the broad cone of depression would broaden and deepen. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N81-17518* National Aeronautics and Space Administration. Pasadena Office, Calif.
SOLAR ENERGY RECEIVER FOR A STIRLING ENGINE Patent
M. Kudret Selcuk, inventor (to NASA) (JPL) Issued 2 Dec. 1980 5 p Filed 6 Apr. 1979 Supersedes N79-20513 (17 - 11, p 1449) Sponsored by NASA
(NASA-Case-NPO-14619-1; US-Patent-4,236,383; US-Patent-Appl-SN-027559; US-Patent-Class-60-641; US-Patent-Class-60-524; US-Patent-Class-126-419) Avail: US Patent and Trademark Office CSCL 10A

A solar energy receiver includes a separable endless wall formed of a ceramic material in which a cavity of substantially cylindrical configuration is defined for entrapping solar flux. An acceptance aperture is adapted to admit to the cavity a concentrated beam of solar energy. The wall is characterized by at least one pair of contiguously related segments separated by lines of cleavage intercepting the aperture. At least one of the segments is supported for pivotal displacement. A thermal-responsive actuator is adapted to respond to excessive temperatures within the cavity for initiating pivoted displacement of one segment, whereby thermal flux is permitted to escape from the cavity. Official Gazette of the U.S. Patent and Trademark Office

N81-17519*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
INITIAL EVALUATION TESTS OF GENERAL ELECTRIC COMPANY 12.0 AMPERE HOUR NICKEL CADMIUM SPACECRAFT CELLS WITH DESIGN VARIABLES
J. D. Harkness 1979 44 p
(NASA Order S-57075-AG)
(NASA-CR-163925; WQEC/C-79-114) Avail: NTIS HC A03/MF A01 CSCL 10C

All evaluation tests were performed at room ambient pressure and temperature, with discharges at a 2 hour rate. Tests consisted of phenolphthalein leak tests, three capacity tests, an auxiliary electrode test, a charge retention test, an internal short test, a charge efficiency test, overcharge tests, and a pressure versus capacity test. Results of the tests and recommendations for improvements in manufacturing are presented. T.M.

N81-17520*# Meridian Corp., Falls Church, Va.
CENTRAL STATION MARKET DEVELOPMENT STRATEGIES FOR PHOTOVOLTAICS Final Report

7 Nov. 1980 70 p refs Sponsored by DOE Prepared for JPL
(Contract JPL-955820)
(NASA-CR-163947; DOE/JPL-955820-80) Avail: NTIS HC A04/MF A01 CSCL 10A

Federal market development strategies designed to accelerate the market penetration of central station applications of photovoltaic energy system are analyzed. Since no specific goals were set for the commercialization of central station applications, strategic principles are explored which, when coupled with specific objectives for central stations, can produce a market development implementation plan. The study includes (1) background information on the National Photovoltaic Program, photovoltaic technology, and central stations; (2) a brief market assessment; (3) a discussion of the viewpoints of the electric utility industry with respect to solar energy; (4) a discussion of commercialization issues; and (5) strategy principles. It is recommended that a set of specific goals and objectives be defined for the photovoltaic central station program, and that these goals and objectives evolve into an implementation plan that identifies the appropriate federal role. Author

N81-17521*# Photowatt International, Inc., Tempe, Ariz.
AUTOMATED ARRAY ASSEMBLY TASK DEVELOPMENT OF LOW-COST POLYSILICON SOLAR CELLS Final Report
Gregory T. Jones Nov. 1980 86 p refs Sponsored by DOE Prepared for JPL
(Contract JPL-955265)
(NASA-CR-163939; DOE/JPL/955265-80/3) Avail: NTIS HC A05/MF A01 CSCL 10A

Development of low cost, large area polysilicon solar cells was conducted in this program. Three types of polysilicon material were investigated. A theoretical and experimenal comparison between single crystal silicon and polysilicon solar cell efficiency was performed. Significant electrical performance differences were observed between types of wafer material, i.e. fine grain and coarse grain polysilicon and single crystal silicon. Efficiency degradation due to grain boundaries in fin grain and coarse grain polysilicon was shown to be small. It was demonstrated that 10 percent efficient polysilicon solar cells can be produced with spray on n+ dopants. This result fulfills an important goal of this project, which is the production of batch quantity of 10 percent efficient polysilicon solar cells. Author

N81-17522*# Solarex Corp., Rockville, Md.
DEVELOPMENT OF A HIGH EFFICIENCY THIN SILICON SOLAR CELL Final Report
G. Storti, J. Culik, and C. Wrigley Dec. 1980 79 p refs Prepared for JPL
(Contracts NAS7-100; JPL-954883)
(NASA-CR-163931; SX/115/F) Avail: NTIS HC A05/MF A01 CSCL 10A

Significant improvements in open-circuit voltage and conversion efficiency, even on relatively high bulk resistivity silicon, were achieved by using a screen-printed aluminum paste back surface field. A 4 sq cm 50 micron m thick cell was fabricated from textured 10 omega-cm silicon which had an open-circuit voltage of 595 mV and AMO conversion efficiency at 25 C of 14.3%. The best 4 sq cm 50 micron thick cell (2 omega-cm silicon) produced had an open-circuit voltage of 607 mV and an AMO conversion efficiency of 15%. Processing modifications are described which resulted in better front contact integrity and reduced breakage. These modifications were utilized in the thin cell pilot line to fabricate 4 sq cm cells with an average AMO conversion efficiency at 25 C of better than 12.5% and with lot yields as great as 51% of starts; a production rate of 10,000 cells per month was demonstrated. A pilot line was operated which produced large area (25 cm) ultra-thin cells with an average AMO conversion efficiency at 25 deg of better than 11.5% and a lot yield as high as 17%. A.R.H.

N81-17523*# General Electric Co., Cincinnati, Ohio. Advanced Energy Programs Dept.
A CONCEPTUAL DESIGN STUDY OF A HIGH TEMPERATURE SOLAR THERMAL RECEIVER (ADDED TASKS 6 AND 7) Final Report
C. S. Robertson, L. R. McCreight, A. Gatti, and H. W. Semon 7 Nov. 1980 39 p refs Prepared for JPL
(Contract JPL-955455)
(NASA-CR-163944; JPL-9950483; AED-EO-48) Avail: NTIS HC A03/MF A01 CSCL 10A

The key component of this concept is a coiled tube of silicon nitride which acts as a heat exchanger appears to be ideal from the standpoint of utilizing structural ceramics at around 2500 F under severe thermal shock conditions. However the size and configuration of this coil are beyond the state of the art for fabricating such materials as silicon nitride and carbide. A two-task program to develop and demonstrate the feasibility of extruding and forming a section of thin walled silicon nitride tubing was undertaken as an addition to the original program. A promising polyvinyl butyral-based binder lubricant was identified. Fourteen full size extrusion experiments were conducted. Two trial firings of 1-1/4 turn helices were made. T.M.

N81-17524*# Carnegie-Mellon Univ., Pittsburgh, Pa. Mechanical Engineering and Public Policy.
REPORT OF AN EXPLORATORY STUDY: SAFETY AND LIABILITY CONSIDERATIONS FOR PHOTOVOLTAIC MODULES/PANELS
A. S. Weinstein and D. G. Meeker Jan. 1981 57 p refs Prepared for JPL
(Contract JPL-955846)
(NASA-CR-163942; JPL-9950490; DOE/JPL-955846-81/1) Avail: NTIS HC A04/MF A01 CSCL 10A

An overview of legal issues as they apply to design, manufacture and use of photovoltaic module/array devices is provided and a methodology is suggested for use of the design stage of these products to minimize or eliminate perceived hazards. Questions are posed to stimulate consideration of this area. A.R.H.

N81-17525*# Westinghouse Electric Corp., Trafford, Pa. Power Circuit Breaker Div.
LOW COST SOLAR ARRAY PROJECT SILICON MATERIALS TASK. DEVELOPMENT OF A PROCESS FOR HIGH CAPACITY ARC HEATER PRODUCTION OF SILICON FOR SOLAR ARRAYS Final Technical Report
Maurice G. Fey 1981 234 p refs Prepared for JPL
(Contract JPL-954589)
(NASA-CR-163943; JPL-9950491; DOE/JPL-954589-80/9) Avail: NTIS HC A11/MF A01 CSCL 10A

The experimental verification system for the production of silicon via the arc heater-sodium reduction of SiCl4 was designed, fabricated, installed, and operated. Each of the attendant subsystems was checked out and operated to insure performance requirements. These subsystems included: the arc heaters/reactor, cooling water system, gas system, power system, Control & Instrumentation system, Na injection system, SiCl4 injection system, effluent disposal system and gas burnoff system. Prior to introducing the reactants (Na and SiCl4) to the arc heater/reactor, a series of gas only-power tests was conducted to establish the operating parameters of the three arc heaters of the system. Following the successful completion of the gas only-power tests and the readiness tests of the sodium and SiCl4 injection systems, a shakedown test of the complete experimental verification system was conducted. T.M.

N81-17526*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
THE DEVELOPMENT AND UTILIZATION OF SOLAR PHOTOVOLTAIC CELLS: AN ASSESSMENT OF THE POTENTIAL FOR A NEW ENERGY TECHNOLOGY
Kelley J. Cyr Jan. 1981 45 p refs
(NASA-TM-58229) Avail: NTIS HC A03/MF A01 CSCL 10A

The Government set the goal of accelerating the adaptation of photovoltaics by reducing system costs to a competitive level and overcoming the technical, institutional, legal, environmental, and social barriers impeding the diffusion of photovoltaic technology. The technology of silicon solar arrays was examined and the status of development efforts are reviewed. The political, legal, economic, social, and environmental issues are discussed, and several methods for selecting development projects are described. A number of market forecasting techniques, including time trend, judgemental, and econometric methods, were reviewed, and the results of these models are presented. T.M.

N81-17527*# Stonehart Associates, Inc., Madison, Conn.
PREPARATION AND EVALUATION OF ADVANCED ELECTROCATALYSTS FOR PHOSPHORIC ACID FUEL CELLS Quarterly Report, Jul. - Sep. 1980
Paul Stonehart, John Baris, and Peter Pagliaro Sep. 1980 30 p refs
(Contract DEN3-176)
(NASA-CR-165179; DOE/NASA/0176-80/3; QR-3) Avail: NTIS HC A03/MF A01 CSCL 10A

Results are presented for hydrogen oxidation and hydrogen oxidation poisoned by carbon monoxide at levels between 0 and 30%. Due to the high activities that are now being observed for our platinum based electrocatalysts, the hydrogen concentrations were reduced to 10% levels in the gas supplies. Perturbation techniques were used to determine that a mechanism for the efficient operation of our porous gas diffusion electrodes is diffusion of the carbon monoxide out of the electrode structure through the electrolyte film on the electro-catalyst. A survey of the literature on platinum group materials (PGM) was carried out so that an identification of successful electrocatalysts could be made. Two PGM electrocatalysts were prepared and performance data for hydrogen oxidation in hot phosphoric acid in the presence of high carbon monoxide concentrations showed that they matched the best platinum on carbon electrocatalysts but with an electrocatalyst cost that was half of the platinum catalyst cost. Author

N81-17528*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF GENERAL ELECTRIC COMPANY, 6.0 AMPERE-HOUR NICKEL-CADMIUM SPACECRAFT CELLS FOR THE GOES-D, E AND F SATELLITE PROGRAM
J. D. Harkness 1979 27 p
(NASA Order S-57075-AG)
(NASA-CR-163923; WQEC/C-79-224) HC A03/MF A01 CSCL 10C

The tests are to insure that all cells put into the life cycle program are of high quality by the screening of cells found to have electrolyte leakage, internal shorts, low capacity, or inability of any cell to recover its open-circuit voltage above 1.150 volts during the internal short test. Test limits specify those values at which a cell is to be terminated from charge or discharge. Requirements are referenced to normally expected values based on past performance of aerospace nickel-cadmium cells with demonstrated life characteristics. Recommendations for the improvement of the manufacturing processes are presented. T.M.

N81-17529*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: CYCLE LIFE TEST Annual Report
J. D. Harkness 1979 321 p
(NASA Order C-13105-D)
(WQEC/C-79-1; AR-15) Avail: NTIS HC A14/MF A01 CSCL 10C

The service life and storage stability for several storage batteries were determined. The batteries included silver-zinc batteries, nickel-cadmium batteries, and silver-cadmium batteries. The cell performance characteristics and limitations are to be used by spacecraft power systems planners and designers. A statistical analysis of the life cycle prediction and cause of failure versus test conditions is presented. T.M.

N81-17530*# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF GENERAL ELECTRIC COMPANY 40.0 AMPERE HOUR NICKEL CADMIUM SPACECRAFT CELLS FOR THE TRACKING DATA RELAY SATELLITE SYSTEM
S. W. Hall 1980 31 p
(NASA Order S-49693-B)
(NASA-CR-163924; WQEC/C-80-194) Avail: NTIS HC A03/MF A01 CSCL 10C

Average end of charge voltages and pressures, and capacity output in ampere hours are presented. Test limits specify those values at which a cell is to be terminated from charge or discharge. Requirements are based on past cell performance data. The requirement does not constitute a limit for discontinuance from testing. The nickel cadmium batteries were screened for internal shorts, low capacity, electrolyte leakage, or inability of any cell to recover its open circuit voltage above 1.150 volts during the internal short test. T.M.

N81-17531*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE PHOTOVOLTAIC RESEARCH AND TECHNOLOGY 1980. HIGH EFFICIENCY, RADIATION DAMAGE AND BLANKET TECHNOLOGY
1980 395 p refs Conf. held in Cleveland, 15-17 Oct. 1980
(NASA-CP-2169; E-469) Avail: NTIS HC A17/MF A01 CSCL 10A

The application of silicon solar cells are discussed with respect to their importance in the exploration of space. Several aspects of the technology associated with the development of photovoltaic devices are reported. For individual titles, see N81-17532 through N81-17576.

N81-17532*# National Aeronautics and Space Administration, Washington, D. C.
NASA'S HIGH EFFICIENCY AND RADIATION DAMAGE SOLAR CELL PROGRAM
Lynwood P. Randolph *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 1-3 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The conversion efficiency and the life expectancy of solar cells and arrays were evaluated for space applications. Efforts were made to improve the understanding of the conversion of electromagnetic radiation to useful forms of energy. A broad range of advanced concepts were evaluated. R.C.T.

N81-17533*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
SOLAR POWER R AND D FOR AIR FORCE SPACE REQUIREMENTS
Joseph F. Wise *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 5-10 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The requirements for improved solar power system technology for DOD satellites are reported. It is shown that the technology is required in several areas including solar cells, array blanket technology, energy storage and power system operation, and regulation and control. It is further shown that as the missions become more critical to defence, military aspects such as survivability, hardening, and eventually defence must be addressed. R.C.T.

N81-17534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT PROGRESS IN HIGH-OUTPUT-VOLTAGE SILICON SOLAR CELLS
A. Muelenberg (COMSAT Labs., Clarksburg, Md.), R. A. Arndt (COMSAT Labs., Clarksburg, Md.), J. F. Allison (COMSAT Labs., Clarksburg, Md.), and V. Weizer *In its* Space Photovoltaic Res. and Technol. 1980 p 11-14 refs (For primary document see N81-17531 08-44)
(Contract NAS3-22217)
Avail: NTIS HC A17/MF A01 CSCL 10A

The status of the technology associated with the development of high output voltage silicon solar cells is reported. The energy conversion efficiency of a double diffusion process is compared to that of a single diffusion process. The efficiency of a 0.1 ohm/cm solar cell is characterized both before and after covering. R.C.T.

N81-17535*# Oak Ridge National Lab., Tenn.
A COMPARISON BETWEEN PULSED AND CW LASER ANNEALING FOR SOLAR CELL APPLICATIONS
G. E. Jellison, Jr., R. T. Young, R. F. Wood, and A. Gat (Coherent Laser, Inc., Palo Alto, Calif.) *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 15-28 refs (For primary document see N81-17531 08-44)

(Contract W-7405-eng-26)
Avail: NTIS HC A17/MF A01 CSCL 10A

The application of laser processing in solar cell fabrication is considered. Specific emphasis is placed on a process developed for the fabrication of a 16.6% silicon solar cell using pulsed laser processing. Results are presented which compare pulsed laser annealing with CW laser annealing in solar cell fabrication. R.C.T.

N81-17536*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF MINORITY CARRIER MOBILITY VARIATIONS ON THE PERFORMANCE OF HIGH VOLTAGE SILICON SOLAR CELLS
V. G. Weizer and M. P. Godlewski *In its* Space Photovoltaic Res. and Technol. 1980 p 29-35 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

A multistep diffusion processing schedule is described which allows the attainment of high open circuit voltages in 0.1 ohm/cm silicon cells. The schedule consists of a deep primary diffusion, followed by an acid etch of emmitter surface which is then followed by a shallow secondary diffusion. A correlation is made between the observed voltage increases and the time of primary diffusion. Results indicate that as the primary diffusion time increases, the voltage rises monotonically. R.C.T.

N81-17537*# Purdue Univ., Lafayette, Ind.
COMPUTER MODELING OF HIGH-EFFICIENCY SOLAR CELLS
R. J. Schartz and M. S. Lundstrom *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 37-50 refs Sponsored by DOE Prepared for Sandia Labs., Albuquerque, N. Mex. (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Transport equations which describe the flow of holes and electrons in the heavily doped regions of a solar cell are presented in a form that is suitable for device modeling. Two experimentally determinable parameters, the effective bandgap shrinkage and the effective asymmetry factor are required to completely model the cell in these regions. Nevertheless, a knowledge of only the effective bandgap shrinkage is sufficient to model the terminal characteristics of the cell. The results of computer simulations of the effects of heavy doping are presented. The insensitivity of the terminal characteristics to the choice of effective asymmetry factor is shown along with the sensitivity of the electric field and quasielectric fields to this parameter. The dependence of the terminal characteristics on the effective bandgap shrinkage is also presented. Author

N81-17538*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL RESULTS ON THE DOUBLE-COLLECTING TANDEM JUNCTION SOLAR CELL
Chandra Goradia (Cleveland State Univ.), John Vaughn (Cleveland State Univ.), and Cosmo R. Baraona *In its* Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 51-59 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Results of computer calculations using a one dimensional model of the silicon tandem junction solar cell with both front and back current collection are presented. Using realistically achievable geometrical and material parameters, the model predicts that with base widths of 50 micrometers and 100 micrometers and base resistivities between 1 ohm/cm and 20 ohm/cm, beginning of life efficiencies of 14% to 17% and end of life efficiencies of 12% to 14%, after about seven years in synchronous orbit, can be obtained. Author

N81-17539*# Northrop Research and Technology Center, Palos Verdes Peninsula, Calif.
MEASUREMENT OF MINORITY-CARRIER DRIFT MOBILITY IN SOLAR CELLS USING A MODULATED ELECTRON BEAM
Siegfried Othmer and M. A. Hopkins *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 61-65 refs Prepared for Midwest Research Inst., Golden, Colo. (For primary document see N81-17531 08-44)
(Contract EG-77-C-01-4042)
Avail: NTIS HC A17/MF A01 CSCL 10A

A determination of diffusivity on solar cells is here reported which utilizes a one dimensional treatment of diffusion under sinusoidal excitation. An intensity-modulated beam of a scanning electron microscope was used as a source of excitation. The beam was injected into the rear of the cell, and the modulated component of the induced terminal current was recovered phase sensitively. A Faraday cup to measure the modulated component of beam current was mounted next to the sample, and connected to the same electronics. A step up transformer and preamplifier were mounted on the sample holder. Beam currents on the order of 400-pA were used in order to minimize effects of high injection. The beam voltage was 34-kV, and the cell bias was kept at 0-V. R.C.T.

N81-17540*# Solarex Corp., Rockville, Md.
SHORT-CIRCUIT CURRENT IMPROVEMENT IN THIN CELLS WITH A GRIDDED BACK CONTACT
Michael Giuliano and John Wohlgemuth *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 67-70 (For primary document see N81-17531 08-44)
(JPL Order LQ-727616)
Avail: NTIS HC A17/MF A01 CSCL 10A

The use of gridded back contact on thin silicon solar cells 50 micrometers was investigated. An unexpected increase in short circuit current of almost 10 percent was experienced for 2 cm x 2 cm cells. Control cells with the standard continuous contact metallization were fabricated at the same time as the gridded back cells with all processes identical up to the formation of the back contact. The gridded back contact pattern was delineated by evaporation of Ti-Pd over a photo-resist mask applied to the back of the wafer; the Ti-Pd film on the controls was applied in the standard fashion in a continuous layer over the back of the cell. The Ti-Pd contacts were similarly applied to the front of the wafer, and the grid pattern on both sides of the cell was electroplated with 8-10 micrometers of silver. R.C.T.

N81-17541*# Communications Satellite Corp., Clarksburg, Md.
SILICON RESEARCH AND TECHNOLOGY WORKSHOP REPORT
A. Meulenberg, Jr. *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 71-72 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The materials, structures, processing, modeling and measurements of high efficiency silicon solar cells were surveyed. In the materials area, highlights included: (1) the possibility of improving cell voltages by reducing minority carrier mobilities in critical regions of the solar cells; (2) the need for and possibility of lowering the surface recombination velocity for improvement of open circuit voltage in shallow junction cells; (3) the present need for improved lifetime in high resistivity cells; and (4) the potential for new materials such as polycrystalline or dendritic web material to perform well at end of life in a radiation environment. In the area of structures, distinction was made between those for terrestrial use and those that would survive radiation environments. Areas such as epitaxial growth and laser or elctron beam annealing (and diffusion) were proposed as having certain advantages over more conventional techniques. R.C.T.

N81-17542*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
THE GaAs SOLAR CELL RESEARCH AND DEVELOPMENT PROGRAMS OF THE AIR FORCE
Kenneth T. Masloski *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 73-78 ref (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The compound GaAs is of interest for space application photovoltaics due to its inherent advantages over silicon. Higher efficiencies, superior radiation hardness, and a greater temperature resistance are the major advantages of GaAs over Si. Air Force programs look for ways of maximizing these advantages while minimizing disadvantages such as higher costs and weights. Four

programs in GaAs photovoltaics are described and each program is discussed in terms of its objective, approach and status. T.M.

N81-17543*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH EFFICIENCY EPITAXIAL GaAs/GaAs AND GaAs/Ge SOLAR CELL TECHNOLOGY USING OM/CVD
K. L. Wang, Y. C. M. Yeh, R. J. Stirn, and S. Swerdling *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 81-85 Sponsored in part by DOE and AF (For primary document see N81-17531 08-44)
(Contract NAS7-100)
Avail: NTIS HC A17/MF A01 CSCL 10A

A technology for fabricating high efficiency, thin film GaAs solar cells on substrates appropriate for space and/or terrestrial applications was developed. The approach adopted utilizes organometallic chemical vapor deposition (OM-CVD) to form a GaAs layer epitaxially on a suitably prepared Ge epi-interlayer deposited on a substrate, especially a light weight silicon substrate which can lead to a 300 watt per kilogram array technology for space. The proposed cell structure is described. The GaAs epilayer growth on single crystal GaAs and Ge wafer substrates were investigated. T.M.

N81-17544*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STUDY OF PROCESS TECHNOLOGY FOR GaAlAs/GaAs HETEROFACE SOLAR CELLS
Edmund J. Conway, Gilbert H. Walker, Charles E. Byvik, and David W. Almgren *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 87-94 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Two processes were considered: the infinite melt process and the finite melt process. The only technique that is developed to the point that 10,000 cells could be produced in one year is the infinite melt liquid phase epitaxy process. The lowest cost per cell was achieved with the advanced metal organic chemical vapor deposition process. Molecular beam epitaxy was limited by the slow growth rate. The lowest cost, an 18 percent efficient cell at air mass zero, was approximately $70 per watt. T.M.

N81-17545*# Varian Associates, Palo Alto, Calif.
HIGH EFFICIENCY COMPOUND SEMICONDUCTOR CONCENTRATOR PHOTOVOLTAICS
Peter Borden, Paul Gregory, Ram Saxena, Richard Owen, and Ozzie Moore *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 95-112 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Special emphasis was given to the high yield pilot production of packaged AlGaAs/GaAs concentrator solar cells, using organometallic VPE for materials growth, the demonstration of a concentrator module using 12 of these cells which achieved 16.4 percent conversion efficiency at 50 C coolant inlet temperature, and the demonstration of a spectral splitting converter module that achieved in excess of 20 percent efficiency. This converter employed ten silicon and ten AlGaAs cells with a dichroic filter functioning as the beam splitter. A monolithic array of AlGaAs/GaAs solar cells is described. T.M.

N81-17546*# Rockwell International Corp., Thousand Oaks, Calif. Electronics Research Center.
STATUS OF ROCKWELL-ERC HIGH EFFICIENCY SOLAR CELL PROGRAMS
S. W. Zehr, J. A. Cape, D. L. Miller, and H. T. Yang *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 113-119 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Programs aimed at developing large area, high efficiency GaAs heteroface cells for low concentration space applications and high concentration terrestrial applications as well as other programs aimed at developing high efficiency multicolor devices for use in similar applications are described. An additional program aimed at achieving improved power to weight ratio by parting thin film solar cells from their growth substrates prior to their incorporation into an array assembly is also described. There is potential for multiple reuse of the substrates which could lead to reduced costs for such devices. Highlights of these programs and their interrelated contributions toward the goals of reducing specific weight, volume and cost of photovoltaic space power systems are discussed. Overall goals are summarized and current programs and their funding sources are listed. T.M.

N81-17547*# Hughes Research Labs., Malibu, Calif.
GaAs WORKSHOP REPORT
G. S. Kamath *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 121-124 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The advantages of GaAs over silicon are discussed. The substrate problem in solar cell fabrication was reviewed. Future trends in solar energy technology were predicted with special emphasis on cost of production. T.M.

N81-17548*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
RESULTS OF THE AIR FORCE HIGH EFFICIENCY CASCADED MULTIPLE BANDGAP SOLAR CELL PROGRAMS
W. P. Rahilly *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 125-129 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The III-V semiconductor materials system that was selected for continued cascade cell development was the AlGaAs cell on GaAs cell structure. The tunnel junction used as transparent ohmic contact between the top cell and the bottom cell continued to be the central difficulty in achieving the program objective of 25 percent AMO efficiency at 25 C. During the tunnel junction and top cell developments it became apparent that the AlGaAs cell has potential for independent development as a single junction converter and is a logical extension of the present GaAs heteroface technology. T.M.

N81-17549*# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
INCORPORATION OF SUPERLATTICE CRYSTAL LAYERS IN MULTIJUNCTION SOLAR CELLS
A. E. Blackslee and K. W. Mitchell *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 131-136 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Superlattice layers are effective in decreasing the density of dislocations in lattice mismatched heterostructures at least four orders of magnitude. Hence it was proposed to utilize this feature of superlattices to alleviate the problems due to misfit dislocations generated in the regions between two or more photovoltaic collecting junctions. A further advantage is that the possibility is presented for using silicon as a low cost substrate as well as for the low band gap junction. In the test case, a silicon low gap cell was connected to a GaAs.7P.3 high gap cell through a connecting region containing a GaAs/GaP superlattice. T.M.

N81-17550*# Research Triangle Inst., Research Triangle Park, N. C.
AlGaAs-GaAs CASCADE SOLAR CELL
M. F. Lamorte and D. H. Abbott *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 137-156 sap HC A17/MF A01 refs (For primary document see N81-17531 08-44)
(Contract F33615-78-C-2077)
Avail: NTIS HC A17/MF A01 CSCL 10A

Computer modeling studies are reported for a monolithic, two junction, cascade solar cell using the AlGaAs GaAs materials combination. An optimum design was obtained through a serial optimization procedure by which conversion efficiency is maximized for operation at 300 K, AM 0, and unity solar concentration. Under these conditions the upper limit on efficiency was shown to be in excess of 29 percent, provided surface recombination velocity did not exceed 10,000 cm/sec. T.M.

N81-17551*# Research Triangle Inst., Research Triangle Park, N. C.
FABRICATION OF AlGaAs/GaAs CASCADE SOLAR CELL BY LPE
S. M. Bedair *In* NASA. Lewis Research Center Space

Photovoltaic Res. and Technol. 1980 p 157-164 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Stacking two or more photovoltaic junctions in electrical and optical series results in higher conversion efficiency since each junction can be tailored to respond more efficiently to a smaller range of photon energies. An efficiency of about 30 percent was predicted for a two junction cascade cell having the optimum bandgap values. A number of III-V materials systems were considered for use in fabricating cascade solar cells. The Al-Ga-As system is attractive from a developmental standpoint since it employs a proven materials system that is closely lattice matched throughout its compositional range. This system employs a GaAs low bandgap cell and 1.9 eV AlGaAs high bandgap cell connected by an AlGaAs tunnel junction. Although this cell does not possess the optimum bandgap values, an efficiency of 25 percent was predicted at 300 K under AMO, 1 sun illumination. T.M.

N81-17552*# Varian Associates, Palo Alto, Calif.
OM-VPE GROWN MATERIALS FOR HIGH EFFICIENCY SOLAR CELLS
Ram Saxena, B. Cooper, III, M. Ludowise, P. Borden, and P. Gregory *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 165-173 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Organometallic sources are available for all the III-V elements and a variety of dopants; thus it is possible to use the technique to grow a wide variety of semiconductor compounds. AlGaAsSb and AlGaInAs alloys for multijunction monolithic solar cells were grown by OM-VPE. While the effort concentrated on terrestrial applications, the success of OM-VPE grown GaAs/AlGaAs concentrator solar cells (23% at 400 suns) demonstrates that OM-VPE is suitable for growing high efficiency solar cells in large quantities for space applications. In addition, OM-VPE offers the potential for substantial cost reduction of photovoltaic devices with scale up and automation and due to high process yield from reproducible, uniform epitaxial growths with excellent surface morphology. T.M.

N81-17553*# Research Triangle Inst., Research Triangle Park, N. C.
CASCADE SOLAR CELL WORKSHOP REPORT
J. A. Hutchby *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 175-180 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Issues related to the feasibility, research and development, and demonstration of a 30% AMO cascade solar cell discussed include the material selection, growth and fabrication techniques, and device development strategy for a monolithic (two terminal) cascade cell, a hybrid (four terminal) cascade cell, and a spectral splitting device (three cells). Workshop recommendations include: (1) initiate a long range research program to develop a three junction, monolithic, cascade cell using either AlGaAsSb-GaAsSb or AlGaInAs-GaInAs material system; (2) emphasize OM-CVD epitaxial growth technique, perhaps combined with other technologies in the near term to obtain tunnel junctions; (3) develop a two junction device first; (4) initiate a cascade solar cell modeling program to study and compare performance of two and four terminal cascade devices exposed to electron and proton irradiation; and (5) envourage and be open to new ideas for developing four terminal, hybrid, cascade cells exploiting novel component cell interconnect technologies. A.R.H.

N81-17554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANNEALING OF RADIATION DAMAGE IN LOW RESISTIVITY SILICON SOLAR CELLS
I. Weinberg and C. K. Swartz *In its* Space Photovoltaic Res. and Technol. 1980 p 181-186 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The reduction of the temperatures required to restore cell performance after irradiation was investigated with emphasis on the annealing characteristics of two groups of cells containing different amounts of oxygen and carbon. Examination of defect behavior in irradiated boron doped silicon leads to the tentative conclusion that further reduction in annealing temperature could be achieved by decreasing the carbon concentration and either neutralizing the divacancy and/or minimizing its formation as a result of irradiation. A significant reduction in the temperature required to remove radiation induced degradation in 0.1 ohm centimeter silicon solar cells was achieved. A.R.H.

N81-17555*# State Univ. of New York, Albany.
MODELING OF RADIATION DAMAGE IN SILICON SOLAR CELLS
Gottlieb Oehrlein, James P. Karins, James W. Corbett, Patricia M. Mooney (Paris VII Univ.), and Bernard Pajor (Paris VII Univ.) *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 187-189 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

One MeV electron irradiation produces preponderantly isolated vacancy interstitial pairs. If neither of these defects is mobile, the concentration of each grows linearly with fluence. Annealing of damage depends on the nature of the damage. Vacancy interstitial pairs which are bound by an interaction such that they mutually annihilate rather than dissociate are termed close pairs; close pair recovery usually occurs at a lower temperature than the temperature at which long distance defect migration occurs. Annealing of the remaining frozen in damage occurs when a temperature is reached where the vacancy or interstitial is mobile; usually the interstitial is more mobile than the vacancy. The recovery occurs in two regimes which may be resoluable. A.R.H.

N81-17556*# Massachusetts Inst. of Tech., Cambridge.
DISTRIBUTION OF OXYGEN IN SILICON AND ITS EFFECTS ON ELECTRONIC CHARACTERISTICS ON A MICROSCALE
H. C. Gatos, P. Rava, and J. Lagowski *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 191-198 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The microdistribution of oxygen in silicon was obtained by scanning IR absorption in as grown Czochralski crystals. The crystals were subsequently submitted to various heat treatments. The profiles of the generated thermal donors were determined by spreading resistance measurements. Contrary to the prevailing views, it was found that the concentration of the activated thermal donors is not strictly a function of the oxygen concentration, but depends strongly on an additional factor, which was shown to be associated with vacancy concentration. These conclusions could only be reached on the basis of microscale characterization. In fact, commonly employed macroscale analysis has led to erroneous conclusions. Author

N81-17557*# National Aeronautics and Stpace Administration. Lewis Research Center, Cleveland, Ohio.
RADIATION DAMAGE IN SILICON NIP SOLAR CELLS
I. Weinberg, C. Goradia (Cleveland State Univ.), C. K. Swartz, and A. M. Hermann *In its* Space Photovoltaic Res. and Technol. 1980 p 199-206 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The performance parameters of n(+) p p(+) silicon solar cells of varying thicknesses with boron doped p base resistivities of 1250 and 84 ohm centimeters were determined. High injection theory was used to analyze the experimental data. Results from an analysis of open circuit voltages show a much greater contribution to V(oc) from the back junction than is the case for the lower resistivity in common use. The base minority carrier distribution is seen to be significant in determining the contribution of V(B), the base contribution to V(oc). Although V(B) is small, its value increases with increasing radiation fluence. In this connection it is noted that, with illumination from the p(+) side, the sign of V(B) becomes positive, and V(B) itself becomes an additive term to V(oc). Diffusion lengths determined under high injection conditions are significantly greater than those obtained under low injection, while damage coefficients under low injection are higher than those obtained under high injection conditions. A.R.H.

N81-17558*# Solarex Corp., Rockville, Md.
RADIATION TOLERANCE OF VERTICAL JUNCTION SOLAR CELLS
Alan Schelnine and John Wohlgemuth *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 207-217 (For primary document see N81-17531 08-44)
(Contract F33615-78-C-2039)
Avail: NTIS HC A17/MF A01 CSCL 10A

Extensive radiation testing of vertical junction (VJ) solar cells demonstrated a radiation tolerance better than both planar silicon cells and at least one type of (AlGa)As-GaAs cell. Due to tradeoffs between short circuit current and open circuit voltage, the end of life (10 to the 16th power 1 MeV electrons/sq cm) maximum power point is nearly independent of bulk resistivity between 2 and 10 ohm cm, increases slightly with increasing wafer thickness between 3 and 11 mils, and increases slightly with increasing groove depth between 1 and 3 mils. Author

N81-17559*# Naval Research Lab., Washington, D. C.
THREE YEAR PERFORMANCE OF THE NTS-2 SOLAR CELL EXPERIMENT
R. L. Statler and D. H. Walker *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 219-228 refs Sponsored in part by AF (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Twelve different solar cell modules from the NTS 2 experiment are functioning after more than three years in a severe trapped radiation orbit of 20,367 km (10,990 nm) circular, 63 deg inclination. The rate of maximum power degradation may be fit to a predicted rate which is based on twice the value of 1 MeV electron equivalent damage fluence calculated from the space electron model AEI 7. The photovoltaic parameters of the cells are compared to their original values to demonstrate rank order of performance. Author

N81-17560*# Boeing Aerospace Co., Seattle, Wash.
EFFECTS OF LOW ENERGY PROTON, ELECTRON, AND SIMULTANEOUSLY COMBINED PROTON AND ELECTRON ENVIRONMENTS IN SILICON AND GaAs SOLAR CELLS
W. E. Horne, A. C. Day, and D. A. Russell *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 229-238 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Degradation of silicon and GaAs solar cells due to exposures to low energy proton and electron environments and annealing data for these cells are discussed. Degradation of silicon cells in simultaneously combined electron and low energy proton environments and previous experimental work is summarized and evaluated. The deficiencies in current solar array damage prediction techniques indicated by these data and the relevance of these deficiencies to specific missions such as intermediate altitude orbits and orbital transfer vehicles using solar electric propulsion systems are considered. Author

N81-17561*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GaAs HOMOJUNCTION SOLAR CELL DEVELOPMENT
Dennis J. Flood, Clifford K. Swartz, and Russell E. Hart, Jr. *In its* Space Photovoltaic Res. and Technol. 1980 p 239-247 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The Lincoln Laboratory n(+)/p/p(+) GaAs shallow homojunction cell structure was successfully demonstrated on 2 by 2 cm GaAs substrates. Air mass zero efficiencies of the seven cells produced to date range from 13.6 to 15.6 percent. Current voltage (I-V) characteristics, spectral response, and measurements were made on all seven cells. Preliminary analysis of 1 MeV electron radiation damage data indicate excellent radiation resistance for these cells. Author

N81-17562*# Hughes Research Labs., Malibu, Calif.
PERIODIC ANNEALING OF RADIATION DAMAGE IN GaAs SOLAR CELLS
R. Y. Loo, R. C. Knechtli, and G. S. Kamath *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 249-256 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Continuous annealing of GaAs solar cells is compared with periodic annealing to determine their relative effectiveness in minimizing proton radiation damage. It is concluded that continuous annealing of the cells in space at 150 C can effectively reduce the proton radiation damage to the GaAs solar cells. Periodic annealing is most effective if it can be initiated at relatively low fluences (approximating continuous annealing), especially if low temperatures of less than 200 C are to be used. If annealing is started only after the fluence of the damaging protons has accumulated to a high value > 10 to the 11th power sq/pcm), effective annealing is still possible at relatively high temperatures. Finally, since electron radiation damage anneals even more easily than proton radiation damage, substantial improvements in GaAs solar cell life can be achieved by incorporating the proper annealing capabilities in solar panels for practical space missions where both electron and proton radiation damage have to be minimized. M.G.

N81-17563*# Florida Univ., Gainesville.
STUDY OF RADIATION INDUCED DEEP-LEVEL DEFECTS IN PROTON IRRADIATED AlGaAs-GaAs SOLAR CELLS
Sheng S. Li *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 257-263 refs (For primary document see N81-17531 08-44)
(Grant NSG-1425)
Avail: NTIS HC A17/MF A01 CSCL 10A

Radiation induced deep-level defects (both electron and hole traps) in proton irradiated AlGaAs-GaAs p-n junction solar cells are investigated along with the correlation between the measured defect parameters and the solar cell performance parameters. The range of proton energies studied was from 50 KeV to 10 MeV and the proton fluence was varied from 10 to the 10th power to 10 to the 13th power P/sq cm. Experimental tools employed include deep-level transient spectroscopy, capacitance-voltage, current voltage, and SEM-EBIC methods. Defect and recombination parameters such as defect density and energy level, capture cross section, carrier lifetimes and effective hole diffusion lengths in n-GaAs LPE layers were determined from these measurements. M.G.

N81-17564*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROTON RADIATION DAMAGE IN BULK N-GaAs
D. C. Liu, J. W. Blue, D. J. Flood, and W. E. Stanchina *In its* Space Photovoltaic Res. and Technol. 1980 p 265-275 refs Prepared in cooperation with Notre Dame Univ., Ind. (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Bulk samples of Te-doped n-type GaAs were irradiated using 10 MeV to 24 MeV protons to fluences between 2 x 10 to the 11th power protons/sq cm and 2 x 10 to the 14th power protons/sq cm. Majority carrier electrical effects were measured using the vanderPauw techniques and it was observed that radiation damage was minimal at the 10 to the 11th power proton/sq cm fluence. For the higher fluences, carrier removal was proportional to Delta E/Delta x for the protons indicating ionization interactions between the protons and atoms. Thermal annealing was observed at 155 C. Author

N81-17565*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANNEALING RADIATION DAMAGED SILICON SOLAR CELLS WITH A COPPER HALIDE LASER
Thomas J. Pivirotto *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 277-280 refs (For primary document see N81-17531 08-44)
(Contract NAS7-100)
Avail: NTIS HC A17/MF A01 CSCL 10A

The use of a multiply pulsed copper halide laser to significantly anneal out the damage to silicon solar cells caused by a simulated space radiation environment is investigated. Preliminary experiments demonstrate that the amount of damage can be decreased by 41% as measured by the maximum power generated. M.G.

N81-17566*# Westinghouse Research and Development Center, Pittsburgh, Pa.
RADIATION TOLERANCE OF BORON DOPED DENDRITIC WEB SILICON SOLAR CELLS

A. Rohatgi *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 281-288 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The potential of dendritic web silicon for giving radiation hard solar cells is compared with the float zone silicon material. Solar cells with n(+)-p-P(+) structure and approximately 15% (AMI) efficiency were subjected to 1 MeV electron irradiation. Radiation tolerance of web cell efficiency was found to be at least as good as that of the float zone silicon cell. A study of the annealing behavior of radiation-induced defects via deep level transient spectroscopy revealed that E sub v + 0.31 eV defect, attributed to boron-oxygen-vacancy complex, is responsible for the reverse annealing of the irradiated cells in the temperature range of 150 to 350 C. M.G.

N81-17567*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
RADIATION DAMAGE WORKSHOP REPORT
W. Patrick Rahilly *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 289-292 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The starting material, cell design/geometry, and cell processing/fabrication for silicon and gallium arsenide solar cells are addressed with reference to radiation damage. In general, it is concluded that diagnostic sensitivities and material purities are basic to making significant gains in end-of-life performance and thermal annealability. Further, GaAs material characterization is so sketchy that a well defined program to evaluate such material for solar cell application is needed to maximize GaAs cell technology benefits. M.G.

N81-17568*# Boeing Aerospace Co., Seattle, Wash.
EVALUATION OF SOLAR CELL COVERS AND ENCAPSULANT MATERIALS FOR SPACE APPLICATION
Dennis A. Russell *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 293-315 ref (For primary document see N81-17531 08-44)
(Contract NAS3-22222)
Avail: NTIS HC A17/MF A01 CSCL 10A

The effects of space radiation (electrons and protons), vacuum, and thermal cycling on a variety of solar cell covers are investigated. Cover materials evaluated include glass resins, 2 mil glass applied with adhesives or electrostatically bonded, and thin plastic films of FEP or PFA applied with adhesive. Solar cells were exposed to environmental conditions simulating those encountered in outer space. These test conditions include 1 MeV electrons, 0.5 MeV protons, and thermal cycling in vacuum. During testing the solar cells were monitored for variations in electrical characteristics and structural changes. M.G.

N81-17569*# Boeing Aerospace Co., Seattle, Wash.
ELECTROSTATIC BONDING OF THIN (APPROXIMATELY 3 MIL) 7070 COVER GLASS TO Ta2O5 AR-COATED THIN (APPROXIMATELY 2 MIL) SILICON WAFERS AND SOLAR CELLS
D. W. Egelkrout and W. E. Horne *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 317-336 refs (For primary document see N81-17531 08-44)
(Contract NAS3-22216)
Avail: NTIS HC A17/MF A01 CSCL 10A

Electrostatic bonding (ESB) of thin (3 mil) Corning 7070 cover glasses to Ta2O5 AR-coated thin (2 mil) silicon wafers and solar cells is investigated. An experimental program was conducted to establish the effects of variations in pressure, voltage, temperature, time, Ta2O5 thickness, and various prebond glass treatments. Flat wafers without contact grids were used to study the basic effects for bonding to semiconductor surfaces typical of solar cells. Solar cells with three different grid patterns were used to determine additional requirements caused by the raised metallic contacts. M.G.

N81-17570*# Boeing Co., Seattle, Wash.
HERMETIC ENCAPSULATION TECHNIQUE FOR SOLAR ARRAYS
Czeslaw Deminet and William E. Horne *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 337-344 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

A concept is presented for encapsulating solar cells between two layers of glass either individually, in panels, or in a continuous process. The concept yields an integral unit that is hermetically sealed and that is tolerant to high temperature thermal cycling and to particulate radiation. Data are presented on both high temperature solar cells and special glasses that soften at low temperatures for use with the concept. The results of encapsulating experiments are presented which show the successful application of the concept to the special high temperature cells. The mechanical feasibility of encapsulating 2 mil cells between two layers of 2 mil glass is also demonstrated. Author

N81-17571*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT DEVELOPMENTS IN LIGHTWEIGHT SOLAR CELL MODULES
J. D. Broder and A. F. Forestieri *In its* Space Photovoltaic Res. and Technol. 1980 p 345-349 refs (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

Two types of lightweight solar cell modules were prepared. The goal is to achieve a module with a power to weight ratio of 350 watts per kilogram. Both structures use thin cells approximately 50 micrometers thick and glass covers approximately 75 micrometers thick. In one structure the glass is bonded to the module using 93-500 silicone adhesive; while the other relies on heat and pressure bonding using FEP as the adhesive. Specific powers of about 335 watts per kilogram were achieved. J.M.S.

N81-17572*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROSPECTS FOR ENHANCING SEP ARRAY PERFORMANCE
John A. Scott-Monck *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 351-361 refs (For primary document see N81-17531 08-44)
(Contract NAS7-100)
Avail: NTIS HC A17/MF A01 CSCL 10A

Three advanced blanket design models, all employing the OAST thin cell, were developed for potential incorporation into the SEP array. The beginning of life (BOL) specific power of the these blankets ranges from 180 to 660 W/kg. Coupling these blanket designs to the baseline SEP array structure yields array specific powers of from 90 to 200 W/kg. It is shown that certain modifications to the SEP array structure, coupled with the advanced blanket designs, could allow the BOL specific power to reach approximately 250 W/kg. J.M.S.

N81-17573*# Astro Research Corp., Carpinteria, Calif.
EFFICIENT STRUCTURES FOR GEOSYNCHRONOUS SPACECRAFT SOLAR ARRAYS
John M. Hedgepeth *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 363-377 refs (For primary document see N81-17531 08-44)
(Contract NAS7-100)
Avail: NTIS HC A17/MF A01 CSCL 10A

Structural concepts for deploying and supporting lightweight solar array blankets for geosynchronous electrical powr are evaluated. First, the requirements for more mass efficient solar arrays is established by describing future needs. Then analytical results are set forth which show that not only must lighter weight blankets be developed but also the supporting structure must be improved proportionately. The SEPS configuration is taken to be the state of the art point of departure for improved structural concepts. Several directions for improvement are indicated. J.M.S.

N81-17574*# Spectrolab, Inc., Sylmar, Calif.
THE HEWAC PILOT LINE EXPERIENCE
M. Gillanders and R. Opjorden *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 379-386 (For primary document see N81-17531 08-44)
(Contract NAS3-21270)
Avail: NTIS HC A17/MF A01 CSCL 10A

Advanced silicon solar cells with both electrical contacts on

the back side of the cell are described. These high efficiency wrap around contact solar cells (HEWACS) utilize a screen printed dielectric insulation layer to isolate the 'n' and 'p' contacts from each other. Development of a device exhibiting high AMO conversion efficiencies is addressed along with the processing of such cells to a point where cell fabrication can be carried out by production personnel under operating production line conditions. J.M.S.

N81-17575*# TRW Defense and Space Systems Group, Redondo Beach, Calif.

DESIGN REQUIREMENTS FOR HIGH-EFFICIENCY HIGH CONCENTRATION RATIO SPACE SOLAR CELLS

H. Rauschenbach and R. Patterson *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 387-400 ref (For primary document see N81-17531 08-44)
(Contract NAS8-32986)
Avail: NTIS HC A17/MF A01 CSCL 10A

A miniaturized Cassegrainian concentrator system concept was developed for low cost, multikilowatt space solar arrays. The system imposes some requirements on solar cells which are new and different from those imposed for conventional applications. The solar cells require a circular active area of approximately 4 mm in diameter. High reliability contacts are required on both front and back surfaces. The back area must be metallurgically bonded to a heat sink. The cell should be designed to achieve the highest practical efficiency at 100 AMO suns and at 80 C. The cell design must minimize losses due to nonuniform illumination intensity and nonnormal light incidence. The primary radiation concern is the omnidirectional proton environment. J.M.S.

N81-17576*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

BLANKET TECHNOLOGY WORKSHOP REPORT

John A. Scott-Monck *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1980 p 401-403 (For primary document see N81-17531 08-44)
Avail: NTIS HC A17/MF A01 CSCL 10A

The solar array blanket, defined as a substrate covered with interconnected and glassed solar cells, but excluding the necessary support structure, deployment, and orientation devices is considered. The interactions between the blanket and the structure that is used to package, deploy, support and, if necessary restow it, are addressed along with systems constraints such as spacecraft configuration, size, and payload requirements. The influence on blanket design is emphasized. The three main mission classes considered are low Earth orbital (LEO), intermediate, or LEO to GEO transfer, and geosynchronous (GEO). Although interplanetary missions could be considered to be a separate class, their requirements, primarily power per unit mass, are generally close enough to geosynchronous missions to allow this mission class to be included within the third type. Examination of the critical elements of each class coupled with considerations of the shuttle capabilities is used to define the type of blanket technology most likely required to support missions that will be flown starting in 1990. J.M.S.

N81-17577# EIC, Inc., Newton, Mass.

EXPLORATORY DEVELOPMENT OF AN ELECTRICALLY RECHARGEABLE LITHIUM BATTERY Final Report, 2 Jul. 1979 - 1 Jul. 1980

K. M. Abraham, J. L. Goldman, M. D. Dempsey, and G. L. Holleck Oct. 1980 87 p refs
(Contract DAAK20-79-C-0267; DA Proj. 1L1-62705-AH-94)
(AD-A093038; DELET-TR-79-0267-F) Avail: NTIS HC A05/MF A01 CSCL 10/3

The cathodic behavior of V6013 was investigated in rechargeable Li cells of the type, Li/2Me-THF,LiAsF6/V6013,C. Two forms of V6013 were synthesized and characterized. These were a stoichiometric form, i.e., V02.17, and a slightly non-stoichiometric form, i.e., V02.19. Stoichiometric V6013 was prepared by heating requisite quantities of V205 and V powder for 24 hrs. at 650 C. The slightly non-stoichiometric V6013 was prepared by the thermal decomposition of NH4V03 at 450 C. The discharge characteristics of the stoichiometric oxide at 60 C were similar to that of non-stoichiometric oxide at room temperature. The rechargeability of both the oxides were found to be sensitive to the lower voltage cutoff. The safest limits of cycling were 3.0 and 1.9V. Potentiostatic discharges of the oxides between 1.9 and 1.3V revealed a high capacity irreversible reduction process at about 1.6V. Three types of hermetically sealed cells were constructed and tested. In a high capacity (5Ah) prismatic cell utilizing the non-stoichiometric oxide, energy densities of 106 Whr/kg and 190 Whr/DM3 were achieved. GRA

N81-17578# Aerospace Corp., Germantown, Md. Environment and Energy Conservation Directorate.

MILITARY WASTES-TO-ENERGY APPLICATIONS

Keith E. Kawaoka Nov. 1980 199 p refs
(AD-A093042; ATR-80(8374)-1) Avail: NTIS HC A09/MF A01 CSCL 13/2

This analysis focuses on the military waste material and byproduct stream and the potential for energy recovery and utilization. Feedstock material includes municipal-type solid waste, selected installation hazardous waste, and biomass residue. The study objectives are to (1) analyze the characteristics of the military waste stream; (2) identify potential energy recovery options; and (3) examine and assess the technical and economic feasibility and environmental and institutional impacts of various energy recovery approaches. Total energy recoverable from DOD solid waste could provide about 2 percent of DOD's facility energy demand. The energy potential available to DOD from biomass and hazardous waste was not available. Available waste-to-energy systems are thermal conversion processes such as incineration with heat recovery. The significance of this recoverable energy from military wastes is put in proper perspective when the benefits and barriers in using waste-derived energy are considered. Some of the benefits of waste-to-energy conversion are as follows: waste energy is a readily available and inexhaustible resource that greatly reduces dependence on imported energy. GRA

N81-17579# Solarex Corp., Rockville, Md.

SILICON SOLAR CELL OPTIMIZATION Interim Report, Aug. 1978 - Feb. 1980

John H. Wohlgemuth and A. L. Scheinine Wright-Patterson AFB, Ohio AFWAL Jun. 1980 78 p refs
(Contract F33615-78-C-2039)
(AD-A092908; AFWAL-TR-80-2059) Avail: NTIS HC A05/MF A01 CSCL 10/2

This research program has resulted in improvements in vertical junction solar cell techniques leading to higher efficiencies and improved handleability. Vertical junction solar cells have now been fabricated with AMO conversion efficiency greater than 15% (25 C). A variety of cells have been fabricated including different groove depths, substrate thicknesses and bulk resistivities. Cell performance has been measured both before and after irradiation. Theoretical analysis has been performed to generate computer models of I-V curves for various cell geometries. These models have been compared with actual cell performance to aid in the understanding of the mechanisms responsible for cell performance. GRA

N81-17580# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

AN ANALYSIS OF WATER-TO-AIR HEAT PUMP SYSTEMS FOR USE IN GOVERNMENT FACILITIES M.S. Thesis

Robert G. Fretzs Sep. 1980 126 p refs
(AD-A093179; AFIT/LSSR-74-80) Avail: NTIS HC A07/MF A01 CSCL 13/1

Energy consumption is an important issue for government managers. Examined in this thesis is one source of potential energy savings: a method of heating and cooling buildings. Water-to-air heat pumps are analyzed and cost comparisons to conventional heating/cooling systems (gas, fuel oil, electric resistance, and air-to-air heat pumps) are made. The theory of heat pump technology is presented to show how water source heat pumps achieve improved efficiencies over conventional systems. Sources of and disposal of water to support the systems are discussed. Cost comparisons are presented based on computer simulations and fuel cost graphs. Twenty-one percent of U.S. energy consumption is used to heat and cool buildings. Water-to-air heat pumps provide a 30-50 percent savings over other systems. Therefore, a potential 10 percent savings in total energy

consumption exists through the use of water source heat pumps. GRA

N81-17581# Duracell International, Inc., Burlington, Mass. Lab. for Physical Science.
LITHIUM-THIONYL CHLORIDE BATTERY Quarterly Report, 1 May - 31 Jul. 1980
A. N. Dey, N. Hamilton, D. Wong, and D. Cubbison Dec. 1980 39 p refs
(Contract DAAB07-78-C-0563; DA Proj. 1L1-62705-AH-94)
(AD-A093140; DELET-TR-78-0563-7) Avail: NTIS HC A03/MF A01 CSCL 01/3

We have made final design changes to improve the anode connections of the flat cylindrical cell. We have also begun fabrication of parts needed for the assembly of at least forty such cells to be delivered to the sponsor in the form of five 8 cell batteries for Laser Designator Applications. We have further investigated the safety of the flat cell during voltage reversal on GLLD load at 3.2A and 20A. We also studied the rate capability retention of these cells after storage. GRA

N81-17582# Friends of the Earth, San Francisco, Calif.
DECENTRALIZED ENERGY STUDIES: COMPENDIUM OF INTERNATIONAL STUDIES AND RESEARCH
Cissy Wallace Mar. 1980 73 p refs Prepared in cooperation with Midwest Research Inst., Golden, Colo.
(Contract EG-77-C-01-4042)
(SERI/RR-744-451) Avail: NTIS HC A04/MF A01

With efficient use of energy, renewable energy sources can supply the majority, if not the totality, of energy supplies in developed nations at real energy prices that double or triple by 2025 (1975 prices). This appears true even in harsh climates with oil dependent industrial economies. Large increases in end-use energy efficiency are cost effective at present prices. Some reports show that cost effective end-use efficiency improvements can reduce energy consumption (per capita, per unit of amenity, or per unit of output) to as much as 90 percent. This was demonstrated by highly disaggregated analyses of end-uses. Such analyses consistently show larger potential for efficiency improvements than can be detected from conventional analyses of more aggregated data. As energy use demands decline due to end use efficiency improvements, energy supply problems subsequently decrease. Lifestyle changes, influenced by social factors, and rising energy prices can substantially reduce demands for energy. Such changes are already discernible in end-use energy studies. When energy efficient capital stock is in place, many end-users of energy will be able to provide a substantial portion of their own energy needs from renewable energy sources that are directly available to them. E.D.K.

N81-17583# Oak Ridge Associated Universities, Tenn. Inst. for Energy Analysis.
COST-ENERGY DYNAMICS: AN ENGINEERING-ECONOMIC BASIS FOR INDUSTRIAL ENERGY CONSERVATION POLICIES
Doan L. Phung and Willem vanGool (Rijksuniversiteit Utrecht, The Netherlands) Oct. 1980 41 p refs
(Contract DE-AC05-76OR-00033)
(ORAU/IEA-80-12(M)) Avail: NTIS HC A03/MF A01

A theory of cost energy dynamics that can be used to shape policies for industrial energy conservation is developed. The theory is built on two relationships commonly observed in process engineering: cost varies as a positive power function of system size and complexity, whereas energy consumption varies as a negative power function of the same attributes. These functions, rooted in thermodynamics, may be combined to yield a technological parameter (denoted c) that can be determined for each unit process. The lower the value of c, the greater the energy savings may be for a given expenditure. Cost energy dynamics ranks energy conservation potentials of industrial processes by the technology parameter c, aggregates energy consumption by unit processes, accounts for energy embodied in the investments, considers the tradeoffs between cost and energy and distinguishes bases for decision making in the public and private sectors. E.D.K.

N81-17584# California Univ., Livermore. Lawrence Livermore Lab.
FLYWHEEL ROTOR AND CONTAINMENT TECHNOLOGY DEVELOPMENMT PROGRAM OF THE UNITED STATES DEPARTMENT OF ENERGY
Satish V. Kulkarni 6 Aug. 1980 55 p refs Presented at 3d Intern. Conf. on Composite Materials, 25-29 Aug. 1980
(Contract W-7405-eng-48)
(UCRL-84713; CONF-800848-2) Avail: NTIS HC A04/MF A01

The status of the flywheel rotor and containment technology development program in the United States is discussed. The specific objectives of the effort are delineated, and prototype composite rotor designs are described. The composite-limited-rotor development efforts discussed, including design modifications to improve energy density, fabrication of thick composite laminates and filament-wound rings, low-cost manufacturing processes, generation of rotor-design data, nondestructive inspection, and spin testing of rotors. The current rotor-burst-containment design philosophy is assessed as well as the applicability of jet-engine fan-blade containment technology to flywheel sysems. Based on this assessment, preliminary design criteria for containment are evolved. A.R.H.

N81-17585# California Univ., Berkeley. Lawrence Berkeley Lab.
CHARACTERIZATION OF SOLID WASTE CONVERSION AND COGENERATION SYSTEMS
Washington DOE Sep. 1980 227 p refs
(Contract W-7405-eng-48)
(DOE/EV-0105) Avail: NTIS HC A11/MF A01

Three basic technologies for recovering energy from Municipal Solid Waste (MSW) were considered: direct combustion using a waterwall incinerator in which the heat from burning refuse is converted to steam by circulating water in steel tubes jacketing the interior of the incinerator; manufacture of a relatively uniform shredded, pulverized or pelleted refuse-derived fuel (RDF) for supplemental firing in a utility boiler; and pyrolysis or destructive distillation of MSW to extract a low-Btu fuel gas. While resource recovery and energy recovery systems can be installed independently, the processes described include both energy and resource recovery systems as well as necessary pollution control equipment for gaseous emissions. DOE

N81-17586# OAO Corp., Washington, D.C.
FUELS AND CHEMICALS MADE FROM SOLAR ENERGY: OPTIONS FOR THE 1990'S AND BEYOND
Aug. 1980 13 p
(Contract DE-AC01-79ET-21051)
(DOE/CS-21051/01) Avail: NTIS HC A02/MF A01

The concept and feasibility of using solar thermal systems to produce gaseous and liquid fuels and feedstocks from non-renewable resources such as coal, lignite, and peat and from renewable resources such as water and waste organic materials are discussed. Some of the commercially important reactions considered as candidates for solar thermal technology are mentioned including synthesis gas production, shale oil processing, decomposition of water, ammonia production, styrene manufacture, and inorganic chemicals processes. DOE research programs in this area are briefly discussed. DOE

N81-17587# Biphase Energy Systems, Inc., Santa Monica, Calif.
EVALUATION OF A TWO-PHASE TURBINE FOR SOLAR ELECTRIC POWER GENERATION Final Report
William E. Amend 17 Nov. 1980 129 p refs
(Contracts DE-AC03-76ET-20431; EY-76-C-03-1255)
(DOE/ET-20431/T1) Avail: NTIS HC A07/MF A01

The Biphase turbine has the potential to produce shaft power at a higher efficiency than conventional Rankine type cycles operating between the same temperature limits. Also, the two phase system has the potential to effectively operate at higher heat source temperatures than the Rankine system without having to employ extremely high pressures. In addition, capital costs of the Biphase system are projected to be some 30 percent below those for an equivalent Rankine vapor system. Since the Biphase turbine is inherently a low speed, high torque device, conventional mechanical elements can be employed to build a highly reliable, low maintenance system. Thus the cost of electrical

power produced from a field of solar collector by a Biphase system is projected to be significantly below that from a Rankine system. The design, fabrication, analysis, and preliminary testing of a 58.7 hp Biphase system designed to produce electrical power from a field of solar collectors delivering energy at 540 F and 500 psia are described. DOE

N81-17588# Argonne National Lab., Ill.
COMMUNITY ENERGY AUDITING: EXPERIENCE WITH THE COMPREHENSIVE COMMUNITY ENERGY MANAGEMENT PROGRAM
J. L. Moore, D. A. Berger, C. B. Rubin, P. A. Hutchinson, Sr., and H. M. Griggs Sep. 1980 107 p refs
(Contract W-31-109-eng-38)
(ANL/CNSV/TM-43) Avail: NTIS HC A06/MF A01

The evaluation issues and key findings based on the communities' experiences from Spring of 1979 to approximately March of 1980 are presented. An organized review of experience of communities in applying the detailed audit methodology for estimating current community energy consumption and projecting future consumption and supply is presented. A preliminary assessment of how audit information is being used in other CCEMP tasks is provided. DOE

N81-17589# Nuovo Pignone S.p.A., Florence (Italy).
CONSTRUCTION OF A COMPLETE ALL SEASON CONDITIONING WITH SOLAR ENERGY OF AN OFFICE BUILDING OF 260 m2 AND ITS OPERATION Final Report
Ferrari G. P. Aggradi 1980 86 p refs
(EUR-6702-EN) Avail: NTIS HC A05/MF A01

The building and the solar plant are described including the control system, and the main ways of operation. The results of the first year tests are reported for every day. A description of the data acquisition system is given, including the type of data, and the measurement frequency required in each case. The main troubles occurred during the test, and the methods used to solve them are described as well. The performance of the collector and the absorption refrigerant units are analyzed. DOE

N81-17590# Little (Arthur D.), Inc., Cambridge, Mass.
CAPITAL COST ESTIMATES OF SELECTED ADVANCED THERMAL ENERGY STORAGE TECHNOLOGIES Final Report
W. Thompson Lawrence Jun. 1980 284 p
(Contract W-31-109-eng-38)
(ANL/SPG-11) Avail: NTIS HC A13/MF A01

A method for evaluating the first cost of diverse advanced thermal energy storage (TES) concepts on a common basis is presented. For a total sample of at least 20 baseline and advanced TES technologies, the methodology developed was to be applied in the calculation of actual cost and performance measures. Work on the development of TES focused on 5 types of applications areas: electric power generation, with solar input in which TES is used to store energy for use during cloudy periods or at night; conventional fuel fired electric power generation, in which TES is used to improve load factors; cyclic losses, in which TES is used to reduce losses that occur when devices start and stop; batch losses, in which TES is used to recover waste heat; and source/sink mismatch, in which TES is used to increase the efficiency of processes that are dependent upon ambient temperatures. DOE

N81-17591# Acres American, Inc., Columbia, Md.
ADIABATIC COMPRESSED AIR ENERGY STORAGE IN HARD ROCK
C. L. Driggs Oct. 1980 29 p refs Presented at the DOE Thermal-Mech. Energy Storage Ann. Contractors Rev. Meeting Prepared for Pacific Northwest Lab., Richland, Wash.
(Contract DE-AC06-76RL-01830)
(PNL-SA-9010) Avail: NTIS HC A03/MF A01

Findings are discussed of a conceptual design study performed which examined pure adiabatic CAES cycles operating in the temperature range of 700 to 900 F. The project involved an investigation of the technical and economic feasibility of using commercially available technology to construct a plant. DOE

N81-17592# Unibilt Industries, Vandalia, Ohio.
PASSIVE AND HYBRID SOLAR MANUFACTURED HOUSING AND BUILDINGS Final Report
Doug Scholz, Curt Bowling, Steven Winter, Emanuel Levy, Rita Marks, and Al Zgolinski 1981 163 p Prepared in cooperation with Winter (Steven) Associates, Inc., New York Prepared for Midwest Research Inst., Golden, Colo.
(Contract DE-FC02-80CS-30384)
(DOE/CS-30384/1) Avail: NTIS HC A08/MF A01

After reviewing alternative insulation, glazing, and water wall schemes, five options were identified for detailed energy use and life cycle cost analysis. Using the PASCALC/SLR analysis procedure, the performance of the base case home and each of the energy conservation options was calculated. DOE

N81-17593# Commission of the European Communities, Brussels (Belgium). Directorate General for Research, Science and Education.
ENERGY: SOLAR ENERGY PROGRAMME OF THE COMMISSION OF THE EUROPEAN COMMUNITIES
1980 181 p
(EUR-6959-EN) Avail: NTIS (US Sales Only) HC A09/MF A01; DOE Depository Libraries

Abstracts are presented of the final reports of projects in the fields of solar energy applications for dwellings, a 1 MWe solar thermal power plant, photovoltaic power generation, and energy from biomass. DOE

N81-17594# Westinghouse Electric Corp., Lester, Pa. Power Systems Co.
OCEAN THERMAL ENERGY CONVERSION POWER SYSTEM DEVELOPMENT: PSD-I, PHASE 2 Final Design Report
30 Jun. 1980 515 p refs
(Contract DE-AC03-79ET-21039)
(DOE/ET-21039/1) Avail: NTIS HC A22/MF A01

The PSD-1 program provides a heat exchanger system consisting of an evaporator, condenser and various ancillaries with ammonia used as a working fluid in a closed simulated Rankine cycle. Primary design concerns include control of biofouling corrosion and erosion of aluminum tubes, selection of materials, and the development of a basis for scale up to large heat exchangers so as to ultimately demonstrate economic feasibility on a commercial scale. The PSD-1 test article was devised to verify thermodynamic, environmental and mechanical performance of basic design concepts. The detailed design, development, fabrication, checklist, delivery, installation support, and operation support for the Test Article Heat Exchangers are described. DOE

N81-17595# Stanford Univ., Calif. Dept. of Materials Science and Engineering.
PHOTOELECTRONIC PROPERTIES OF ZINC PHOSPHIDE CRYSTALS, FILMS AND HETEROJUNCTIONS Quarterly Progress Report, 1 Jul. - 30 Sep. 1980
Richard H. Bube 1980 17 p refs Sponsored by DOE Prepared for Midwest Research Inst., Golden, Colo.
(SERI/PR-8031-1-T2; QPR-6) Avail: NTIS HC A02/MF A01

The role of crystalline defects and impurities in Zn3P2, the nature of the electronic charge transport in single crystal and thin film material, and the properties of photovoltaic heterojunctions involving Zn3P2 were studied. The scope of the program extends from basic investigations of materials properties on single crystals to the preparation and characterization of all thin film heterojunction devices. One of the principal motivations behind this research program is the realization that Zn3P2 is a relatively uninvestigated yet ideal component for photovoltaic heterojunction use in solar energy conversion. The program concentrates on the basic materials problems involved with Zn3P2, providing the kind of information needed for other more developmental program directed toward actual practical cells. Results are reported. DOE

N81-17596# Mueller Associates, Inc., Baltimore, Md.
PROGRAM PLAN FOR RELIABILITY AND MAINTAINABILITY IN ACTIVE SOLAR HEATING AND COOLING SYSTEMS
Oct. 1980 62 p refs
(Contract DE-AC01-80CS-36010)
(DOE/CS-36010/01) Avail: NTIS HC A04/MF A01

Specific objectives are as follows: provide all groups that have solar R & M concerns with the information that is available

to the program and that can assist in alleviating those concerns; assist the solar energy industry in improving levels of R & M performance in state of the art solar energy systems, components, and materials; assist in the early development of a viable infrastructure for the design, manufacture, installation, and maintenance of reliable, maintainable, and durable solar energy systems; assist in the development of appropriate standards, code provisions, and certification programs relating to the R & M performance of solar energy systems, components, and materials; and develop the information required to support the other activities within the R & M program. These objectives correspond to five areas of action: regulations, research and development, technology transfer, solar industry infrastructure development, and data collecton and analysis. T.M.

N81-17597# Battelle Inst., Frankfurt am Main (West Germany).
ENERGY: ECONOMIC ACTIVITY AND ENERGY DEMAND; LINK TO ENERGY FLOW. EXAMPLE: FRANCE
1980 112 p Sponsored by Commission of the European Communities
(EUR-6773-EN) Avail: NTIS (US Sales Only) HC A06/MF A01; DOE Depository Libraries

The data derived from the EXPLOR and EPOM, Energy Flow Optimization Model are described. The core of the EXPLOR model is a circular system of relations involving consumer's demand, producer's outputs, and market prices. The solution of this system of relations is obtained by successive iterations; the final output is a coherent system of economic accounts. The computer program for this transition is described. The work conducted by comparing different energy demand models is summarized. The procedure is illustrated by a numerical projection to 1980 and 1985 using the existing version of the EXPLOR France model. DOE

N81-17598# Yale Univ., New Haven, Conn. Dept. of Political Science.
US SOLAR ENERGY POLICY FOR LESS DEVELOPED COUNTRIES
B. Russett Oct. 1980 55 p refs
(Contract DE-AC02-79CS-10048)
(DOE/CS-10048/T1) Avail: NTIS HC A04/MF A01

While remaining sensitive to engineering and economic considerations, concentration is on some political and sociological issues which will have great affect on decisions whether and how to make use of solar energy technology in less developed countries (LDCs). Only with an understanding of these issues and with answers to some of the questions raised can there be any serious effort to devise a satisfactory United States government policy for the promotion of solar energy applications abroad. Tentative propositions outlining issues about which further information is required are based on the results of interviews in the United States, India and the Middle East, and an analysis of various reports by private individuals, national and transnational organizations, and government agencies. DOE

N81-17599# Urban Options, East Lansing, Mich.
***URBAN OPTIONS SOLAR GREENHOUSE DEMONSTRATION PROJECT* Final Report**
Lori Cipparone 15 Oct. 1980 163 p
(Contract DE-FG02-79R5-10128)
(DOE/R5-10128/2) Avail: NTIS HC A08/MF A01

The following are included: the design process, construction, thermal performance, horticulture, educational activities, and future plans. Included in appendices are: greenhouse blueprints, insulating curtain details, workshop schedules, sample data forms, summary of performance calculations on the Urban Options Solar Greenhouse, data on vegetable production, publications, news articles on the Solar Greenhouse Project, and the financial statement. DOE

N81-17600# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
APPROPRIATE SIZING OF SOLAR HEATING SYSTEMS
P. Bendt Sep. 1980 33 p refs
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TR-333-320) Avail: NTIS HC A03/MF A01

It is demonstrated that the uncertainty in future economic trends makes the results of system sizing by minimizing its life cycle cost questionable. The design conditions for minimum cost are extremely broad and all practical systems have a solar fraction within the limited range of 30 percent to 90 percent. Thus, by choosing only three collector areas that give systems within this range, one is assured of selecting a nearly optimal system for any realistic economic scenario. Selecting one of these three systems is essentially equivalent to economic optimization, but simpler. Procedures are derived for determining the sizes of the three systems. The conclusion is that the collector areas should be about 1/8, 1/5, and 1/3 of the building floor area. This rule of thumb eliminates the need to design solar systems individually, allowing the possibility of mass produced homes with standardized solar heating systems. DOE

N81-17601# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
COMBUSTION, PYROLYSIS, GASIFICATION, AND LIQUEFACTION OF BIOMAS
T. B. Reed Sep. 1980 15 p refs Presented at Energy from Biomass Conf., Brighton, England, 4-7 Nov. 1980
(Contracts DE-AC02-77CH-00178; EG-77-C-01-4042)
(SERI/TP-622-893; CONF-801130) Avail: NTIS HC A02/MF A01

The advantages of biomass as a feedstock are examined and biomass conversion techniques are described. Combustion is the simplest method of producing heat from biomass, using either the traditional fixed bed combustion on a grate or the fluidized bed and suspended combustion techniques now being developed. Pyrolysis of biomass is a particularly attractive process if all three products gas, wood tars, and charcoal can be used. Gasification of biomass with air is perhaps the most flexible and best developed process for conversion of biomass to fuel, yielding a low energy gas that can be burned in existing gas/oil boilers or in engines. Oxygen gasification yields a gas with higher energy content that can be used in pipelines or to fire turbines. In addition, this gas can be used for producing methanol, ammonia, or gasoline by indirect liquefaction. Fast pyrolysis of biomass produces a gas rich in ethylene that can be used to make alcohols or gasoline. Finally, treatment of biomass with high pressure hydrogen can yield liquid fuels through direct liquefaction. DOE

N81-17602# Battelle Pacific Northwest Labs., Richland, Wash.
SEASONAL THERMAL ENERGY STORAGE PROGRAM
James E. Minor 1980 46 p refs
(Contract DE-AC06-76RL-01830)
(PNL-SA-9030) Avail: NTIS HC A03/MF A01

Seasonal thermal energy storage technology is described. Demonstration programs involving aquifers, environmental effects studies, legal aspects, economics, numerical simulation, and field testing are discussed. DOE

N81-17603# Brookhaven National Lab., Upton, N. Y. Dept. of Energy and Environment.
CARBON MONOXIDE: RESOURCE OF THE FUTURE
R. S. Sapienza, W. A. R. Slegeir, R. I. Goldberg, and B. Easterling
1980 9 p refs Presented at the 3rd Intern. Coal Util. Exhibition and Conf., Houston, Tex., 18-20 Nov. 1980
(Contract DE-AC02-76CH-00016)
(BNL-28576; CONF-801142-1) Avail: NTIS HC A02/MF A01

Opinions and ideas under study by the Catalysis Group at Brookhaven National Laboratory (BNL) on the effective production and use of carbon monoxide and synthesis gas are described. The use of carbon monoxide is important for the successful introduction of coal for fuel production and for the petrochemical industry. The kinetics of fast producer reactions and slow producer reactions are described. DOE

N81-17604# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESIDENTIAL USE OF PHOTOVOLTAICS
E. C. Kern, Jr. 1980 7 p refs Presented at 1980 Photovoltaic Solar Energy Conf., Cannes, France, 27-31 Oct. 1980
(Contract DE-AC02-76ET-20279)
(DOE/ET-20279/109; CONF-801097-2) Avail: NTIS HC A02/MF A01

Residential electricity demand data and forecasts for France, Japan and the United States are presented as background information pertinent to the market for solar photovoltaic power

systems. Current residential photovoltaic system development activities in the United States were reviewed. Issues related to the eventual adoption of such systems are discussed. DOE

N81-17605# Ontario Research Foundation, Mississauga.
SOLAR ENERGY PROGRAM: PROTECTIVE SOLAR COLLECTOR SYSTEMS FROM CORROSION
[1981] 35 p refs Sponsored by National Research Council, Ottawa, Ontario
(NP-25154) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

Corrosion by galvanic means is described and methods of fabrication which minimize this type of corrosion are discussed. Minimizing corrosion at the design and operating stages of a solar heating system by properly choosing materials, coatings, and heat transfer fluids is considered. DOE

N81-17606# Babcock and Wilcox Co., Alliance, Ohio.
STUDY OF SEED-REPROCESSING SYSTEMS FOR OPEN-CYCLE COAL-FIRED MHD POWER PLANTS.
A. Sheth (Argonne National Lab.) Jul. 1980 63 p refs Prepared in cooperation with J. E. Sirrine Co.
(Contract DE-AC02-79ET-15613)
(DOE/ET-15613-T1-App) Avail: NTIS HC A04/MF A01

Of the several processes that are capable of separating sulfur from potassium sulfate, the process developed by Pittsburgh Energy Research Center (PERC), and the Formate process were selected for the detailed mass and energy balance calculations. As a basis for the calculations, an MHD power plant of 450 Mwt size and burning Illinois no. 6 coal was selected. In the mass balance calculations, the role played by various trace impurities was included to the extent of current knowledge about such impurities and their impacts on process chemistry. The results given should be considered as preliminary values because various simplifying assumptions were made and factors such as heat losses and component efficiencies were excluded. On the basis of net energy requirements, the Formate process showed a slight advantage; however, it produced a potentially unacceptable sludge as the sulfur containing waste. DOE

N81-17607# Brown, Boveri und Cie, A.G., Heidelberg (West Germany). Zentrales Forschungslabor.
DEVELOPMENT OF SODIUM/SULFUR BATTERIES Final Report
Roland Bauer, Wilfried Fischer, Wilhelm Haar, Bernd Hartmann, Herbert Kleinschmager, Henner Meinhold, and Gert Weddigen Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 125 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-60; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karisruhe, West Germany DM 26,05

The principle of an Na/S storage battery was defined, problems were identified and solved, and a 10 kW hr experimental battery was built and successfully tested. In particular the beta-alumina solid electrolyte was optimized with respect to electrical conductivity and lifetime. Furthermore, the sulfur electrode with respect to sulfur utilization and the cathode current collector case with respect to corrosion resistance were also optimized. Cells used in the experimental battery (60 to 90 W hr/kg depending on charge/discharge time) were cycled up to 350 times. Capacity declines 3 to 30% during this time, the rate being dependent on casing material. The results obtained with single cells. Extrapolation of the experimental results permits the conclusion that the properties necessary for application can be achieved. The energy density of cells optimized with respect to weight is shown to be 165 W hr/kg. However, problems in achieving higher energy density, longer lifetime, and better thermal insulation still exist. Author (ESA)

N81-17608# Battelle Inst., Frankfurt am Main (West Germany).
DEVELOPMENT OF A CADMIUM SELENIDE THIN FILM SOLAR CELL Final Report
Dieter Bonnet Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 86 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fure Forschung und Technologie
(BMFT-FB-T-79-72; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Katisruhe, West Germany DM 18,50

A CdSe MIS thin film solar cell was developed. Fourteen materials were studied with regard to their suitability as I-layers. Two these compounds, i.e., ZnSe and Sb2Se3, give cells with relatively high photovoltage and high photocurrent. The preparation procedure for the 2 micron thick active CdSe film was optimized with respect to all essential parameters. Commercial, nominally very pure CdSe material from six manufactures was found either to be unsuited or to lead to properties greatly varying from batch to batch. The best results were reproducibly obtained with a material directly synthesized from the elements which are commercially available in highly pure form. Experimental cells achieve efficiencies of 4.5%. Short circuit current densities of more than 25 mA/sq cm for incident solar radiation of 100 mV/sq cm and open circuit voltages around 600 mV are obtained. Further enhancement of the photovoltage up to 700 to 800 mV seems possible by suitable doping of the CdSe layer and compensation of the doping near the surface. This as well as an enhancement of the fill factor from 55 to 70% can lead to cells of 9 to 10% efficiency. Author (ESA)

N81-17609# Kernforschungsanlage, Juelich (West Germany). Gesellschaft mit beschraenkter Haftung.
TEST STATIONS FOR FLAT PLATE COLLECTORS IN IRAN, BRAZIL AND INDIA Final Report
K. Scharmer and U. Kleinhaus Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 15 p ref In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-94; ISSN-0340-7608) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karisruhe, West Germany DM 3,40

A solar collector test facility was developed to evaluate the characteristics of flat plate collectors. The collectors are described. Three collector setups were sent to research institutes in Iran, Brazil and India. These test facilities will determine the extent of collector development in those countries and test collectors under the climatic conditions of the three countries. Author (ESA)

N81-17610# Oak Ridge National Lab., Tenn. Data Management Analysis Group.
END USE ENERGY CONSUMPTION DATA BASE: TRANSPORTATION SECTOR
John N. Hooker, Axel B. Rose, and David L. Greene Feb. 1980 461 p refs
(Contract W-7405-eng-26)
(PB81-112203; DOE/DF-81/002A) Avail: NTIS HC A20/MF A01 CSCL 10A

The transportation fuel and energy use estimates developed at Oak Ridge National Laboratory (ORNL) for the end use energy consumption data base are documented. The transportation data generally cover each of the ten years 1967 to 76, with omissions in some modes. The estimates are broken down by mode of transport, by fuel, by region and state, by the sector of the economy providing the transportation and by the use to which it is put, and in the case of automobile and bus travel by the income of the traveler. The mode, fuel, sector, and use categories themselves subname one, two, or three levels of subcategories, resulting in a very detailed categorization of energy use. GRA

N81-17611# TRW, Inc., McLean, Va. Energy System Planning Div.
ENERGY/ECONOMIC MODEL ANALYSIS. VOLUME 1: GAS TECHNOLOGY ASSESSMENTS USING THREE ENERGY SUPPLY/DEMAND INTEGRATING MODELS Final Report
Stanley Cohen Jun. 1980 109 p refs Sponsored by Gas Research Inst. 2 Vol.
(PB81-114225; GRI-79/0052.1) Avail: NTIS HC A06/MF A01 CSCL 10A

The main outputs of the three models are forecasts of the energy (in Btu's) supplied or converted by various technologies and the prices associated with such supply or conversion. Forecasts are made at points in time during the period of 1980-2025. GRA

N81-17612# TRW, Inc., McLean, Va. Energy Systems Planning Div.
ENERGY/ECONOMIC MODEL ANALYSIS. VOLUME 2: EVALUATION OF ENERGY SUPPLY/DEMAND INTEGRATING MODELS Final Report
Stanley Cohen Jun. 1980 86 p refs Sponsored by Gas Research Inst. 2 Vol.
(PB81-114233; GRI-79/0052.2) Avail: NTIS HC A05/MF A01 CSCL 10A

The main objective of this evaluation is to give GRI and its advisors insight into how useful each model is in meeting the objectives of a particular GRI activity. A second major objective is to furnish insight on the similarities and differences of the numerical output associated with the R&D assessment project. GRA

N81-17613# Jorgenson (Dale W.) Associates, Cambridge, Mass.
ENERGY/ECONOMIC MODEL ANALYSIS. MACROECONOMIC IMPACTS OF RESEARCH AND DEVELOPMENT IN GAS SUPPLY AND END USE TECHNOLOGIES Final Report
Richard J. Goettle, IV and Edward A. Hudson Jun. 1980 73 p Sponsored by Gas Research Inst. Prepared for TRW, Inc., McLean, Va.
(PB81-114258; GRI-79/0052.4) Avail: NTIS HC A04/MF A01 CSCL 10A

The Gas Research Institute (GRI) needs to consider the economic impact of the various technologies whose research and development is supported by GRI funding. Three energy-economic models are useful for such a technology assessment. These models are: Energy Economic Modeling System, Energy Policy Model, and Time Stepped Energy System Optimization/Long Term Inter-Industry Transaction Model. These three models were used to help in the economic impact evaluation of various GRI research and development programs. GRA

N81-17614# Decision Focus, Inc., Palo Alto, Calif.
ENERGY/ECONOMIC MODEL ANALYSIS. ENERGY ECONOMIC MODELING SYSTEM Final Report
Dale M. Nesbitt and Donna B. Oman Jun. 1980 329 p refs Sponsored by Gas Research Inst. Prepared for TRW, Inc., McLean, Va.
(PB81-114274; GRI-79/0052.6) Avail: NTIS HC A15/MF A01 CSCL 10A

The Decision Focus Incorporated (DFI) Energy-Economy Model is an integrating model designed in part to focus on two budget-related decisions. Specifically, the DFI model provides a robust but simply way of computing the benefits of successful R&D both in the aggregate and at the level of individual R&D projects. GRA

N81-17615# Brookhaven National Lab., Upton, N. Y.
ENERGY/ECONOMIC MODEL ANALYSIS. TIME-STEPPED ENERGY SYSTEM OPTIMIZATION MODEL Final Report
A. S. Kydes and J. Rabinowitz Jun. 1980 137 p refs Sponsored by Gas Research Inst. Prepared for TRW, Inc., McLean, Va.
(PB81-114241; GRI-79/0052.3) Avail: NTIS HC A07/MF A01 CSCL 10A

The energy results from the Brookhaven National Laboratory/Dale W. Jorgenson Associates energy-economy system as executed under GRI specifications are presented. It is intended to serve as a complement to the DJA report on the macroeconomic consequences of these specifications. GRA

N81-17616# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY/ECONOMIC MODEL ANALYSIS. LIVERMORE ENERGY POLICY MODEL Final Report
Robert B. Bell Jun. 1980 135 p Sponsored by Gas Research Inst. Prepared for TRW, Inc., Mclean, Va.
(PB81-114266; GRI-79/0052.5) Avail: NTIS HC A07/MF A01 CSCL 10A

The results of a study done by the Energy and Resources Planning Group of the Lawrence Livermore Laboratory (LLL) for the Gas Research Institute (GRI) using the LLL Economic Modeling System (EMS) are described. The purpose was to allow GRI to evaluate the appropriateness of their continued use of an energy model and, at the same time, for them to gain a better understanding of the consequences of current or proposed GRI supported research and development. GRA

N81-17617*# Acurex Corp., Mountain View, Calif. Environmental Div.
SURVEY OF EPA FACILITIES FOR SOLAR THERMAL ENERGY APPLICATIONS Final Report, 1 Nov. 1977 - 30 Jun. 1978
E. V. Nelson, P. T. Overly, and D. M. Bell Oct. 1980 155 p refs
(Contract EPA-68-03-2567)
(NASA-CR-162469; EPA-600/7-80-176; PB81-109316; ACUREX-80-40/EE) Avail: NTIS HC A08/MF A01 CSCL 13A

A study was done to assess the feasibility of applying solar thermal energy systems to EPA facilities. A survey was conducted to determine those EPA facilities where solar energy could best be used. These systems were optimized for each specific application and the system/facility combinations were ranked on the basis of greatest cost effectiveness. GRA

N81-17618# Swedish Council for Building Research, Stockholm.
THERMOCHEMICAL ENERGY STORAGE: PROCEEDINGS FROM THE INTERNATIONAL SEMINAR ON THERMOCHEMICAL ENERGY STORAGE
Gunnar Wettermark 1980 420 p refs Seminar held at Stockholm, 7-9 Jan. 1980 Sponsored in part by Swedish National Board for Technical Development, Swedish National Board for Energy Source Development and Royal Swedish Academy of Engineering Sciences
(PB81-114324; ISBN-91-540-3301-2; IVA-MEDDELANDE-229) Avail: NTIS HC A18/MF A01 CSCL 10C

Energy storage problems are explored. Tomorrow's energy sources will provide a continuous flow of energy. Matching supply and demand will necessitate a wide range of storage capabilities. For storing heat thermochemical and economic solutions may take advantage of the various options inherent in this kind of storage, namely heat pumping, transport of heat and direct conversion to other desired forms of energy such as electricity and mechanical work. There is a need to regularly summarize the knowledge and research in the field of thermochemical energy storage in different parts of the world. GRA

N81-17619# Institute of Gas Technology, Chicago, Ill.
FUEL CELL SUPPORT STUDIES: ON-SITE MOLTEN CARBONATE SYSTEMS Final Report, 1 Dec. 1978 - 30 Nov. 1979
Ronald M. Bowman, Bassam J. Jody, Kuang C. Lu, and Keith F. Blurton Gas Research Inst. Oct. 1980 214 p refs Sponsored by Gas Research Inst.
(PB81-113672; GRI-79/0067) Avail: NTIS HC A10/MF A01 CSCL 10B

The potential energy savings which could be obtained from industrial cogeneration using molten carbonate fuel cells are assesses. A natural gas-fueled molten carbonate fuel cell system was configured, and its efficiency and the quantity and quality of its rejected heat were calculated. Potential energy savings, environmental benefits, and impact on overall gas consumption from using the system in a cogenerative mode in 13 selected energy-intensive industries were determined. General equations were derived for the calculation of potential energy savings using any cogeneration system. GRA

N81-17620# National Technical Information Service, Springfield, Va.
ENERGY POLICY AND RESEARCH PLANNING. CITATIONS FROM THE NTIS DATA BASE Progress Report, Oct. 1977 - Sep. 1980
Audrey S. Hundemann Sep. 1980 260 p Supersedes NTIS/PS-79/1069 and NTIS/PS-78/0962
(PB81-800112; NTIS/PS-79/1069; NTIS/PS-78/0962) Avail: NTIS HC $30.00/MF $30.00 CSCL 10A

Citations relative to planning for future U.S. energy needs on both national and state government levels are presented. The history and development of national and state legislation and regulations, Project Independence studies, and assessment of the effects of deregulation are included. Technical, economic,

and environmental considerations in energy planning are also covered. This updated bibliography contains 254 citations, 77 of which are new entries to the previous edition. T.M.

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N81-17621# *National Commission on Air Quality, Washington, D.C.*

REPORT OF THE NATIONAL COMMISSION ON AIR QUALITY (PRELIMINARY STAFF DRAFT)

15 Jan. 1981 651 p refs

Avail: NTIS HC A99/MF A01

Alternatives available to current policies that will protect and enhance the quality of the nation's air resources are discussed. The economic, technical, and environmental consequences of *achieving, or not achieving, the purposes of the Clean Air Act* were calculated. The differing technological, economic, energy, and environmental effects of controlling oxides of nitrogen from *mobile sources relative to stationary sources were described.* Air pollutants not presently regulated that may pose a future *threat to health or welfare were investigated. The extent to* which air quality research programs adequate was reviewed. T.M.

N81-17622*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TWO-DIMENSIONAL MODEL STUDIES OF THE EFFECT OF SUPERSONIC AIRCRAFT OPERATIONS ON THE STRATOSPHERIC OZONE CONTENT

R. C. Whitten, W. J. Borucki, I. G. Poppoff (Flick Point Associates, Carnelian Bay, Calif.), L. Latt (Aerospace Corp., El Segundo, Calif.), G. F. Widhopf (Aerospace Corp., El Segundo, Calif.), L. A. Capone *(San Jose State Univ.), and C. A. Reigel (San Jose State Univ.)*

Feb. 1981 72 p refs

(NASA-RP-1064; A-8270) Avail: NTIS HC A04/MF A01 CSCL 13B

For a fleet of 250 aircraft, the change in the ozone column *is predicted to be very close to zero; in fact, the ozone overburden* may actually increase as a result of show that above 25 to 30 km the ozone abundance decreases via catalytic destruction, *but at lower heights it increases, mainly as a result of coupling* with odd hydrogen species. Water vapor released in the engine exhaust is predicted to cause ozone decreases; for the hypothetical engines used in the study, the total column ozone changes due to water vapor emission largely offset the predicted ozone increases due to NOx emission. The actual effect of water vapor may be less than calculated because present models do not include thermal feedback. Feedback refers to the cooling effect of additional water vapor that would tend to slow the NOx reactions which destroy ozone. T.M.

N81-17623*# Northwestern Univ., Evanston, Ill.

TRANSPORT JET AIRCRAFT NOISE ABATEMENT IN FOREIGN COUNTRIES: GROWTH, STRUCTURE, IMPACT. VOLUME 1: EUROPE, JULY 1980 Final Report

Frank A. Spencer Jul. 1980 230 p refs

(Grant NsG-2328)

(NASA-CR-152356) Avail: NTIS HC A11/MF A01 CSCL 13B

The development and implementation of aircraft noise control regulations in various European states are described. The countries include the United Kingdom, France, Switzerland, Federal Republic of Germany, Sweden, Denmark, and the Netherlands. Topics discussed include noise monitoring, airport curfews, land use planning, and the government structure for noise regulation. T.M.

N81-17624*# Northwestern Univ., Evanston, Ill.

TRANSPORT JET AIRCRAFT NOISE ABATEMENT IN FOREIGN COUNTRIES: GROWTH, STRUCTURE, IMPACT. VOLUME 2: PACIFIC BASIN, AUGUST 1980 Final Report

Frank A. Spencer Aug. 1980 202 p

(Grant NsG-3238)

(NASA-CR-152357-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 13B

Noise control measures at the international airports of Hawaii, *New Zealand, Australia, Hong Kong, Japan, and Singapore were* studied. Factors in noise control, such as government structure are examined. The increasing power of environmental agencies *vis-a-vis aviation departments is noted. The following methods* of dealing with aircraft noise are examined by type of control: noise at the source control; noise emmission controls, zoning, *building codes, subsidies for relocation, insulation, loss in property* values, and for TV, radio and telephone interference; and noise-related landing charges. T.M.

N81-17625# California Univ., Riverside. Statewide Air Pollution Research Center.

ATMOSPHERIC CHEMISTRY OF HYDRAZINES: GAS PHASE KINETICS AND MECHANISTIC STUDIES Final Report, Sep. 1978 - Jun. 1980

James N. Pitts, Ernesto C. Tuazon, William P. L. Carter, Arthur M. Winer, and Geoffrey W. Harris Tyndall AFB, Fla. AFESC Aug. 1980 89 p refs

(Contract F08635-78-C-0307; AF Proj. 1900)

(AD-A093486; AFESC/ESL-TR-80-39) Avail: NTIS HC A05/MF A01 CSCL 21/9

Relatively little work has been done on the atmospheric chemistry of nitrogen-containing compounds such as amines and *hydrazines, which are widely used in industrial and military* applications. However the discovery of compounds such as N-nitrosamines in the environment and concern regarding their *impact on man indicate the need to further elucidate the role* of nitrogenous compounds in the atmosphere. The Air Force is presently assessing the environmental impact of the Space *Transportation System which uses hydrazines as one of the fuels.* In addition, hydrazine is used as a propellant in the F-16 for emergency power. Both uses will result in potential atmospheric releases which should be controlled to a degree dictated by the impact of hydrazines on ambient air quality. Thus, the present study wa designed to experimentally evaluate the atmospheric fate of unsubstituted hydrazine (N_2H_4), monomethylhydrazine (MMH), and unsymmetrical dimethylhydrazine (UDMH). GRA

N81-17626# Miami Univ., Fla.

ATMOSPHERIC TRITIUM

H. G. Oestlund and A. S. Mason 1980 76 p refs

(Contract DE-AS05-76EV-03944)

(DOE/EV-03944/17) Avail: NTIS HC A05/MF A01

Research progress for the year 1979 to 1980 are reported. Concentrations of tritiated water vapor, tritium gas and tritiated hydrocarbons in the atmosphere at selected sampling points are presented. DOE

N81-17627# Stanford Univ., Calif. Electronics Lab.

IONOSPHERIC MODIFICATION BY ROCKET EFFLUENTS Final Report

P. A. Bernhardt, K. M. Price, and A. V. daRosa 1 Jun. 1980 64 p refs

(Contract W-31-109-eng-38)

(ANL/EES/TM-100) Avail: NTIS HC A04/MF A01

The ionospheric effects of the rocket launches which will be required to place the Satellite Power System (SPS) in operation were estimated. Computational tools were developed for numerical simulation of ionospheric changes produced by the injection of rocket exhaust vapors. The theoretical work dealt with the limitations imposed by condensation phenomena in rocket exhaust; complete modeling of the ionospheric depletion process including neutral gas dynamics, plasma physics, chemistry and thermal processes; and the influence of the modified ionosphere on radio wave propagation. Electron content measurements made during the launch of HEAO C on Sept. 20, 1979 are reported. DOE

N81-17628# Walther Cie A.G., Cologne (West Germany). Bereich Umweltschutztechnik.

PROCESS FOR REMOVING SULFUR OXIDES FROM GASES WITH DIRECT PRODUCTION OF A USABLE FINISHED REACTION PRODUCT Final Report

Ulrich Mohn Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 25 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-79-90; ISSN-0340-7608) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 5,50

The feasibility of a scrubbing process for the removal of sulfur oxides from factory flue gases is shown. Laboratory experiments to define the reaction chemistry of adding gaseous ammonia compounds to flue gases were cpnducted. Results led to the construction of a pilot plant for processing 20,000 cu m/hr of flue gas. The sulfur oxides are absorbed in the scrubbing process. Concentration of the scrubbing liquid is increased to a salinity level close to the saturation point. The scrubbing liquid is fed into an oxidation facility and finally spray dried in a hot flue-gas flow. The resulting product is separated as dry ammonia sulfate powder in an electrostatic precipitator. The end product can be directly used and is availabe dry without application of external heat. No external heat is required for reheating of the cleaned gases. No waste water is produced during the process.
Author (ESA)

N81-17629# University of Southern California, Los Angeles. Medical Center.
CORRELATIVE AND SENSITIVE DISCRIMINANTS FOR AIR QUALITY CONTROL (YEAR 1) Final Report, 26 Jul. 1977 - 31 Oct. 1978
Russell P. Sherwin 15 Jul. 1980 109 p refs Sponsored in part by Air Resources Board, Sacramento, Calif.
(PB81-111379; ARB-R-80/128) Avail: NTIS HC A06/MF A01 CSCL 06F

The lungs of 120 Swiss-Webster mice, equally divided into control and exposed groups (intermittent 0.34 ppm nitrogen dioxide for six weeks) were analyzed for numbers of Type 2 cells (greater or less than 8 microns, 10 microns, and 12 microns in diameter), Type 2 cell area, alveolar wall area (no sizing and greater or less than 10 microns in thickness), internal surface area, and linear intercepts. The finding of a new human silicate lung disease is reported. The overall findings are consistent with an accelerated loss and damage of Type 1 cells following short-term NO2 exposure that may or may not be reversible.
GRA

N81-17630# National Oceanic and Atmospheric Administration, Washington, D. C.
REPORT TO THE CONGRESS ON OCEAN POLLUTION AND OFFSHORE DEVELOPMENT Annual Report, Oct. 1977 - Sep. 1978
May 1980 94 p
(PB81-118333; NOAA-80093001; AR-6) Avail: NTIS HC A05/MF A01 CSCL 08J

The sixth annual report on NOAA's research activities presents the highlights that contributed to a better understanding of the marine environment and the effect of human activities upon it. Four principal areas of concern were addressed: petroleum hydrocarbons, chlorinated (manmade) hydrocarbons, metals, and biological hazards.
GRA

N81-17631# Northrop Services, Inc., Research Triangle Park, N. C.
APTI COURSE 435, ATMOSPHERIC SAMPLING. STUDENT MANUAL
M. L. Wilson, D. F. Elias, R. C. Jordan, O. G. Durham, and K. C. Joerger Sep. 1980 392 p refs
(Contract EPA-68-02-2374)
(PB81-121444; EPA-450/2-80-004) Avail: NTIS HC A17/MF A01 CSCL 05B

Contents include: an introduction to atmospheric sampling; basic gas properties and mathematical manipulations; air measuring instruments; particulate sampling; gaseous sampling; and generation of standard test atmospheres; Standard methods for criteria pollutants are described. Continuous air monitoring instrumentation design of surveillance networks, and statistical techniques employed in atmospheric sampling are discussed. Theory and calibration procedures for a rotameter and Federal register reference methods are included.
GRA

N81-17632# Northrop Services, Inc., Research Triangle Park, N. C.
APTI COURSE 435, ATMOSPHERIC SAMPLING. INSTRUCTOR'S GUIDE
M. L. Wilson, D. F. Elias, R. C. Jordan, K. C. Joerger, B. M. Ray, and J. C. Henry Feb. 1980 252 p
(Contract EPA-68-02-2374)
(PB81-121436; EPA-450/2-80-006) Avail: NTIS HC A12/MF A01 CSCL 05B

The Guide contains lesson plans, laboratory instructions, exams, and solutions to problem sets. The lesson plans include keys to APTI audio-visual materials and suggested instructional techniques. These materials are intended for use in conjunction with Student Manual PB81-121444 and Student Laboratory and Exercise Manual EPA 450/2-80-005.
GRA

N81-17633# Radian Corp., McLean, Va.
DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE STEAM ELECTRIC POINT SOURCE CATEGORY Interim Report
John W. Lum and Teresa F. Wright Sep. 1980 618 p refs
(Contract EPA-68-01-5163)
(PB81-119075; EPA-440/1-80-029B) Avail: NTIS HC A99/MF A01 CSCL 13B

A technical basis is provided for the revision of chemical effluent limitations guidelines for the steam electric power industry reflecting the best available technology economically achievable (BATEA) for existing sources, new source performance standards (NSPS), and pretreatment standards. The analysis of pollutant and the technologies applicable to their control was based on specific wastestreams of concern.
GRA

N81-17634# SCS Engineers, Long Beach, Calif.
THE COST OF ALTERNATIVE FLUE GAS DESULFURIZATION (FGD) SLUDGE DISPOSAL REGULATIONS Progress Report, Sep. 1978 - Apr. 1980
John P. Woodyard and Howard L. Fishel Nov. 1980 135 p refs
(Contract EPA-68-03-2471)
(PB81-118895; EPA-600/2-80-178) Avail: NTIS HC A07/MF A01 CSCL 13B

Various sludge treatment and disposal options were delineated. Current federal and state regulations affecting FGD disposal are discussed, and placed in a conceputal framework from which regulatory scenarios were developed. The scenarios were applied to the current (1980) and projected (1985) FGD capacity to estimate what changes, if any, would need to be made in current utility operations to achieve compliance. Using the best available cost data base for these disposal alternatives, region specific cost estimates were developed for 10 model power plants for each of five disposal options. Applying each regulatory scenario, the cost impact on the utility industry was estimated for the 50 different situations.
GRA

N81-17635# Wapora, Inc., Washington, D. C.
ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR NEW SOURCE COAL GASIFICATION FACILITIES Final Interim Report
Robert N. Rickles and D. Keith Whitenight Aug. 1980 108 p refs
(Contract EPA-88-01-4157)
(PB81-114555; EPA-130/6-80-001) Avail: NTIS HC A06/MF A01 CSCL 13B

Guidance on identification of potential wastewater effluents, air emissions and solid wastes from coal gasification facilities; assessment of the impacts of such residuals on the quality of the environment; state of the art technology for in process and end of process control waste streams; evaluation of alternatives; and environmental regulations that apply to industry are included. In addition, the guidelines include an 'overview' chapter that gives a general description of the coal gasification industry, significant problems associated with it, and recent trends in location, raw materials, processes, pollution control, and the demand for industry output.
GRA

N81-17636# Coordinating Research Council, Inc., Atlanta, Ga.
INFORMATIONAL REPORT: 1979 PROGRESS OF THE CHEMICAL CHARACTERIZATION PANEL OF THE COMPOSITION OF DIESEL EXHAUST PROJECT AND RESULTS

OF PARTICULATE EXTRACTION ROUND-ROBIN Progress Report, 1979
Mar. 1980 75 p refs
(CRC Proj. CAPI-1-64)
(PB81-114670; CRC-516; CRC-APRAC-CAPI-1-64-516) Avail: NTIS HC A04/MF A01 CSCL 13B

Chemical characterization methods for unregulated diesel emissions are described. Chemical analysis methods to measure unregulated emissions are validated. The extraction of particle bound material is discussed as well. GRA

N81-17637# TRC Environmental Consultants, Inc., Wethersfield, Conn.
EXPOSURE TO POLLUTANTS FROM DOMESTIC COMBUSTION SOURCES: A PRELIMINARY ASSESSMENT Final Report, Aug. 1979 - Feb. 1980
Edward T. Brookman and Amnon Birenzvige Apr. 1980 51 p refs
(Contract EPA-68-02-3115)
(PB81-111536; EPA-600/7-80-084) Avail: NTIS HC A04/MF A01 CSCL 13B

Results of a preliminary assessment of exposure to pollutants from domestic combustion sources are given some of which emit airborne particulate matter CO, and polycyclic organic matter (POM) near human receptors. Transient ambient concentrations of these pollutants at the receptor (and the corresponding time-averaged exposured) were determined for the following domestic combustion sources: lawn mowing, chain sawing, charcoal cooking, indoor gas cooking, and indoor side-stream smoke. An experimental test program utilizing personal monitoring equipment was conducted to acquire data for the lawn mower, chain saw, and charcoal grill sources. These sources probably do not result in exposures to combustion-generated pollutants that are relatively significant. GRA

N81-17638# Research Triangle Inst., Research Triangle Park, N. C.
THE EMISSIONS INVENTORY SYSTEM/POINT SOURCE USER'S GUIDE
Larry R. McMaster May 1980 824 p refs
(Contract EPA-68-02-3011)
(PB81-114100; EPA-450/4-80-10) Avail: NTIS HC A99/MF A01 CSCL 09B

When dealing with atmospheric pollution, it is necessary to amass, catalog, sort, evaluate and perform calculations upon large volumes of data. The Emissions Inventory System/Point Source provides air pollution control agencies with the capability to create and maintain their own data bases of point source data and to retrieve data and generate reports from those data bases. Step procedures for the operation of each program in the system are given. Each program has sections containing a description, file formats, options, error messages, catalogues JCL (IBM), warnings and special instruction, cost considerations, and related programs and procedures. GRA

N81-17639# Research Corp. of New England, Wethersfield, Conn.
A CASE STUDY IN THE USE OF AMBIENT DATA FOR SOURCE ASSESSMENT Final Report, May - Aug. 1979
Edward T. Brookman and John E. Yocum Apr. 1980 36 p
(Contract EPA-68-02-2615)
(PB81-114316; EPA-600/7-80-080) Avail: NTIS HC A03/MF A01 CSCL 13B

Results were used to provide air quality standards for total suspended particulate matter (TSP). Techniques used in this ambient-correlation study include: analysis of present air quality and trends; log-normal distributions; relative frequency TSP levels; monthly variations in TSP levels; wet-dry/dry-day analysis; wind frequency analysis; isopleth maps; contribution of steel plant emissions by modeling; and particulate identification analysis. The integrated application of these techniques to determine the background traditional and nontraditional components of the ambient TSP levels is described. Study results include estimates of the relative source strengths of the particulates, the relative impacts of the sources, and the level of confidence of these results. GRA

N81-17640# Southern Research Inst., Birmingham, Ala.
A MANUAL FOR THE USE OF ELECTROSTATIC PRECIPITATORS TO COLLECT FLY ASH PARTICLES Final Report, Dec. 1978 - Feb. 1980
Jack R. McDonald and Alan H. Dean May 1980 785 p refs
(Contract EPA-68-02-2114)
(PB81-112757; SORI-EAS-80-066; Rept-3540-7; EPA-600/8-80-025) Avail: NTIS HC A99/MF A01 CSCL 13B

The collection of fly ash particles (produced by the combustion of pulverized coal) by electrostatic precipitation (ESP) is considered. The manual covers fundamentals of ESP, mechanical and electrical components of ESP's, factors influencing ESP performance, measurement of important parameters, advantages and disadvantages of cold-side, hot-side, and flue-gas-conditioned ESPs, safety aspects, maintenance, troubleshooting, the use of a computer model for ESP, and features of a well-equipped ESP. Studies considered in this report include those, by various individuals and organizations, on comprehensive performance evaluations of full-scale ESPs, in situ and laboratory measurement of fly ash resistivity, rapping reentrainment, evaluations of the effects of flue gas conditioning agents on ESP performance, fundamental operation of hot-side ESPs, basic laboratory experiments, and development of a mathematical model of ESP. GRA

N81-17641# Tetra Tech, Inc., Lafayette, Calif.
METHODOLOGY TO EVALUATE THE POTENTIAL FOR GROUND WATER CONTAMINATION FROM GEOTHERMAL FLUID RELEASES Final Report
Karen Summers, Steve Gheirini, and Carl Chen Aug. 1980 178 p refs
(Contract EPA-68-03-2671)
(PB81-111114; EPA-600/7-80-117) Avail: NTIS HC A09/MF A01 CSCL 13B

Analytical methods and graphical techniques are presented for predicting potential ground water contamination from geothermal energy development. Overflows and leaks from ponds, pipe leaks, well blowouts, leaks from well casing, and migration from injection zones can be handled by the methodology. General characteristics of geothermal systems and fluids and probable modes of release are included to provide typical data. GRA

N81-17642# Institute of Gas Technology, Chicago, Ill.
HIGH-TEMPERATURE HIGH-PRESSURE PARTICULATE REMOVAL IN COAL GASIFICATION Final Report, 1 Sep. 1978 - 1 Jan. 1980
William F. Rush, Jr. and Michael Onischak Gas Research Inst. Oct. 1980 50 p refs Sponsored by Gas Research Inst.
(PB81-113664; GRI-78/0046) Avail: NTIS HC A03/MF A01 CSCL 13B

Sonic agglomeration and crossflow filtration were evaluated as techniques for removing fine particulates from high temperature, high pressure gas streams. Cold flow tests provided information about the feasibility of solid membrane crossflow filtration and sonic agglomeration to remove 1 to 10 micron particulates from dust-laden gas streams. Subsequent tests were conducted in high temperature high pressure equipment at operating conditions up to 265 C (509F), and 7000 kPa (1999 psia). Solid membrane crossflow filtration removed at least 98 percent of the particulates from the 95% fraction of entering gas. GRA

N81-17643# Meteorology Research, Inc., Altadena, Calif.
APPLICATION OF COMPUTER GRAPHICS TO AIR QUALITY DATA ANALYSIS
A. H. Vanderpol Feb. 1980 82 p refs
(Grant NSF ENV-77-12487)
(PB81-113623; MRI-80-FR-1735; NSF/RA-800156) Avail: NTIS HC A05/MF A01 CSCL 13B

The utility of analyzing large scientific data analysis programs on a small computer was demonstrated by analyses of acid rain chemistry data. The analysis focused on understanding and quantifying analytical errors in the data and providing statistics for development of a simple photochemical model. Errors in the data base resulted from the processes of collecting the rain water, analyzing it for ions, and recording the values. A statistical approach was employed to identify and correct errors in the data base. Atmospheric sulfate and nitrate formation rates are interdependent and nonlinear. GRA

N81-17644# Foster Associates, Inc., Washington, D.C.
A STATISTICAL STUDY OF COAL SULFUR VARIABILITY AND RELATED FACTORS Final Report
George R. Warholic, John E. Morton, Yimin Ngan, James E. Spearman, and Yvonne Harris May 1980 265 p refs
(Contract EPA-68-02-2592)
(PB81-111585; EPA-450/5-80-008A) Avail: NTIS HC A12/MF A01 CSCL 13B

Coal analysis data and power plant continuous monitoring data were gathered, reviewed and analyzed to assess the impact of fuel coal characteristics on compliance strategies and emission regulations. Analyses indicated that the heat content (Btu/lb) was best approximated by the normal distribution, of which the sulfur content and pounds sulfur/MMBtu were best represented by the inverted gamma distribution which was slightly superior to the lognormal distribution. Analysis of available continuous monitoring data supported the inverse relationship between coal sulfur variability and lot size, i.e., significant reductions in relative variability of emissions occur as the averaging time increases. The various analyses of coal sulfur variability identified no reliable method for coal suppliers or consumers to predict variability which may be critical for compliance by some coal-fired boilers to existing sulfur emission-limiting regulations. GRA

N81-17645# Hittman Associates, Inc., Columbia, Md.
PROCEEDINGS: EPA/INDUSTRY FORUM ON COAL-LIQUEFACTION
Dorothy G. Weatherby Sep. 1980 179 p Forum held at Chicago, 23-24 Oct. 1979
(Contract EPA-68-02-3147)
(PB81-113052; HIT-C1005/402-80-938; EPA-600/9-80-054; IERL-RTP-1112) Avail: NTIS HC A09/MF A01 CSCL 13B

Representatives of government and industry met with the goal of sharing information and increasing cooperation between the two groups. Synthetic fuels, standards-setting procedures, activities, and plans relating to coal liquefaction were discussed for air emissions, solid wastes, and liquid effluents. Permit procedures were summarized for coal liquefaction plants. State government participation in coal liquefaction development was discussed for Kentucky and Illinois. Industry plans in the area of coal liquefaction were presented by representatives of several firms actively involved in development and use of the technology. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N81-17646 Saint Louis Univ., Mo.
MAXIMUM ENTROPY SPECTRAL ANALYSIS OF TWO-DIMENSIONAL MAGNETIC AND ANOMALIES Ph.D. Thesis
Marco Polo Pereira DaBoaHora 1980 213 p
Avail: Univ. Microfilms Order No. 8101251

In a sense the maximum entrophy method (MEM) was considered in the geophysical and statistical literature, among others, as a high resolution method for peak resolution of a given time or spatial series. The shape of the power spectrum, however, was generally neglected. The possibility of using the MEM for accurate determination of the shape of the power spectrum of anomalies due to simple two dimensional bodies when only a short segment of data is available was investigated. It was concluded that the type of MEM to be used in spectral shape determination should be the integrated maximum entropy method (IMEM) which gives the area of each spectral peak in the power spectrum. Since the MEM assumes that the input time or spatial series is whitened by a prediction filter, the length of such a filter is then required to be known. A new set of criteria is presented, which was shown to work well in most theoretical and real case anomalies studied. Dissert. Abstr.

N81-17647*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COORDINATED IONOSPHERIC AND MAGNETOSPHERIC OBSERVATIONS FROM THE ISIS 2 SATELLITE BY THE ISIS 2 EXPERIMENTERS. VOLUME 3: HIGH-LATITUDE CHARGED PARTICLE, MAGNETIC FIELD AND IONOSPHERIC PLASMA OBSERVATIONS DURING NORTHERN SUMMER
Nov. 1980 259 p refs
(NASA-TM-82279; NSSDC/WDC-A-R&S 80-05) Avail: NTIS HC A12/MF A01 CSCL 04A

A list of ISIS 2 experiments and a description of the satellite are presented. Instrumentation of the satellite included an auroral scanning photometer, a red line photometer, a swept frequency sounder, an ion mass spectrometer, and triaxial fluxgate magnetometer. Data format descriptions are provided. Included with the geophysical data set is a list of all passes. T.M.

N81-17648*# Johns Hopkins Univ., Baltimore, Md.
THE ELECTRICAL CONDUCTIVITY OF THE EARTH'S UPPER MANTLE AS ESTIMATED FROM SATELLITE MEASURED MAGNETIC FIELD VARIATIONS Ph.D. Thesis
Edna M. Didwall 1981 174 p refs
(Contract NCC5-18; Grant NsG-5269)
(NASA-CR-163938) Avail: NTIS HC A08/MF A01 CSCL 08G

Low latitude magnetic field variations (magnetic storms) caused by large fluctuations in the equatorial ring current were derived from magnetic field magnitude data obtained by OGO 2, 4, and 6 satellites over an almost 5 year period. Analysis procedures consisted of (1) separating the disturbance field into internal and external parts relative to the surface of the Earth; (2) estimating the response function which related to the internally generated magnetic field variations to the external variations due to the ring current; and (3) interpreting the estimated response function using theoretical response functions for known conductivity profiles. Special consideration is given to possible ocean effects. A temperature profile is proposed using conductivity temperature data for single crystal olivine. The resulting temperature profile is reasonable for depths below 150-200 km, but is too high for shallower depths. Apparently, conductivity is not controlled solely by olivine at shallow depths. A.R.H.

N81-17649*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SATELLITE-TRACKING AND EARTH DYNAMICS RESEARCH PROGRAMS Semiannual Progress Report, 1 Jul. - 31 Dec. 1980
Feb. 1981 101 p
(Grant NGR-09-015-002)
(NASA-CR-163977; SAPR-43) Avail: NTIS HC A06/MF A01 CSCL 08G

The major focus for operations during this period was the preliminary MERIT Campaign and its intensive tracking of LAGEOS for polar motion and Earth rotation studies. The data acquired from LAGEOS were used for other geophysical investigations, including studies of crustal dynamics, and Earth and ocean tides, and for the general development of precision orbit determination. The network performed regular tracking of several other retroreflector satellites including GEOS-1, GEOS-3, BE-C, and Starlette for refined determinations of station coordinates and Earth's gravity field and for studies of solid Earth dynamics. T.M.

N81-17650# Massachusetts Univ., Amherst. Amherst Astronomy Research Facility.
STUDY OF BACKGROUND RADIANCE IN UPPER ATMOSPHERE Final Report, 1 Jul. 1975 - 30 Sep. 1979
Hajime Sakai Hanscom AFB, Mass. AFGL Jan. 1980 86 p refs Sponsored in part by Defense Nuclear Agency
(Contract F19628-75-C-0187; AF Proj. 2310)
(AD-A092927; UMASS-ARF-80-308; AFGL-TR-80-0048) Avail: NTIS HC A05/MF A01 CSCL 04/1

The work of this contract was intended to develop the atmospheric model which integrates the emission and the scattering term in a combined form and to provide analysis of the Earth atmospheric emission data gathered by the SPIRE payload in these two terms. Our work performed throughout the entire period can be divided into five areas: (1) incorporation of various computer programs designed to calculate the atmospheric infrared emission level under a specific condition;

(2) improvement of the algorithm employed in these programs; (3) development of an atmospheric infrared radiance model which unifies the emission and scattering term; (4) application and evaluation of the developed model to analysis of the SPIRE data; and (5) evaluation of some preliminary test data for the coming AFGL balloon-borne atmospheric emission measurement experiment. GRA

N81-17651# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.

PRECIPITATION OF INNER-ZONE ELECTRONS BY WHISTLER MODE WAVES FROM THE VLF TRANSMITTERS UMS AND NWC Interim Report

H. C. Koons, B. C. Edgar, and A. L. Vampola 1 Dec. 1980 53 p refs

(Contract F04701-80-C-0081; Grant NSF ATM-77-28187)

(AD-A092919; TR-0081(6969-05)-6; SD-TR-80-76) Avail: NTIS HC A04/MF A01 CSCL 20/14

A ray tracing analysis using a diffusive equilibrium model showed that 17.1 kHz waves starting with vertical wave normals between 23 and 31 degrees magnetic latitude cross the magnetic equator between L approximately equal to 1.6 and L approximately equal to 1.8 with wave normals of approximately 63 degrees. A relativistic cyclotron resonance analysis for the same model plasmasphere using the ray tracing results gave an energy vs L shell dependence for the precipitated electrons which is in excellent agreement with the observed dependence. T.M.

N81-17652# Naval Research Lab., Washington, D. C.

THE CURRENT CONVECTIVE INSTABILITY AS APPLIED TO THE AURORAL IONOSPHERE

P. K. Chaturvedi and S. L. Ossakow 19 Dec. 1980 25 p refs

(RR0330244)

(AD-A093220; NRL-MR-4415) Avail: NTIS HC A02/MF A01 CSCL 01/1

We extend the previous analysis of the current convective instability as applied to the diffuse auroral situation (Ossakow and Chaturvedi, 1979) to include ion inertial effects, important at high altitudes; and to the case in which ions are highly collisional (non-magnetized), a situation which is realized at E-region altitudes. In the inertial domain the instability growth rates are comparable to those found in the collision dominated domain. This extends the applicability of the instability process to high altitudes. The relevance of the instability to the E-region is discussed. Finally, electromagnetic effects, which can be important for long wavelengths, are considered and are found to be small in ionospheric situations. GRA

N81-17653# Naval Research Lab., Washington, D. C.

NUMERICAL SIMULATIONS OF EQUATORIAL SPREAD F USING ALTAIR INCOHERENT BACKSCATTER MEASURED ELECTRON DENSITY PROFILES FROM THE 17 JULY 1979 DNA KWAJALEIN CAMPAIGN

S. T. Zalesak and S. L. Ossakow 3 Dec. 1980 29 p refs Sponsored in part by Defense Nuclear Agency

(AD-A092961; NRL-MR-4389) Avail: NTIS HC A03/MF A01 CSCL 04/1

Using electron density profiles measured by the ALTAIR radar on 17 July 1979, we have performed global large scale size numerical simulations of the nonlinear evolution of the collisional Rayleigh-Taylor instability in the equatorial ionosphere. The ALTAIR profiles were taken approximately four and one-half hours prior to the onset of equatorial spread F. Using 5% amplitude sinusoidal initial perturbations in our numerical simulations, we find fully developed spread F bubbles (plumes) on time scales of approximately one-half hour for both small (8 km) and large (200 km) horizontal scale lengths. GRA

N81-17654# Communications Research Centre, Ottawa (Ontario).

AN F-LAYER MODEL OF THE IONOSPHERE FOR NORTH AMERICA

C. J. Gladwin Sep. 1980 78 p refs

(AD-A093139; CRC-1337) Avail: NTIS HC A05/MF A01 CSCL 04/1

Data collected from the Alouette 1 and 2 satellites (ALOSYN and ALOUETTE N(h)) have been organized in order to make predictions of ionospheric characteristics such as foF2, slab thickness, and spread F as functions of longitude, latitude, local time, month, magnetic activity, and sunspot number. Spread F and foF2 are determined statistically from about 1 million Alouette-1 ionograms and slab thickness is estimated using about 100,000 electron density profiles. The data and the necessary computer programs for analysing these data by the user are on two labelled tapes and are available from the Communications Research Center. Contour maps of foF2, spread F and slab thickness as a function of geographic latitude and local time can be generated. A special technique is outlined in order that the user may modify his results to include the main trough. The major computer programs used are available on request. GRA

N81-17655# Air Force Global Weather Central, Offutt AFB, Nebraska.

RADIATION CORRECTIONS USED IN THE AFGWC STRATOSPHERIC ANALYSIS MODELS

Terry C. Tarbell and Francis G. Tower Sep. 1980 21 p refs

(AD-A093195; AD-E850005; AFCWC/TN-80/004) Avail: NTIS HC A02/MF A01 CSCL 04/2

At stratospheric levels, radiosonde temperature sensors are affected not only by the ambient air temperature but also by direct short-wave solar radiation and by long-wave radiation. The short-wave radiation causes a radiosonde temperature sensor to sense a temperature warmer than the ambient air. The long-wave radiation causes the temperature sensor to measure a temperature cooler than the ambient air. This technical note describes how corrections are applied to radiosonde temperature observations to account for the effects of short and long-wave radiation. GRA

N81-17656# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.

VLF EMISSIONS FROM A MODULATED ELECTRON BEAM IN THE AURORAL IONOSPHERE Final Report

Robert H. Holzworth and Harry C. Koons 15 Nov. 1980 21 p refs

(Contracts F04701-80-C-0081; NOAA-03-5-022-95)

(AD-A093765; TR-0081(6960-05)-1; SD-TR-80-77) Avail: NTIS HC A02/MF A01 CSCL 04/1

A discrete VLF frequency of 3 kHz was successfully radiated by a modulated electron beam on a rocket launched into an active aurora. Instrumentation on this flight included a programmable electron accelerator on the aft section with various particle and field detectors on the aft section as well as the ejected forward payload. The accelerator programmer included a current modulation period at fixed electron energy for 0.45 seconds duration approximately every 11 seconds throughout the flight. GRA

N81-17657# Pennsylvania State Univ., University Park. Ionosphere Research Lab.

IMPROVED DATA REDUCTION AND ANALYSIS SYSTEM FOR BLUNT PROBE AND GERDIEN CONDENSER MEASUREMENTS Final Report

Darryl C. Schroder White Sands Missile Range, N. Mex. ERADCOM Oct. 1980 120 p refs

(Contract DAAD29-76-D-0100)

(AD-A093649; ERADCOM/ASL-CR-80-0100-3) Avail: NTIS HC A06/MF A01 CSCL 21/1

Measurements of electrical conductivity over the altitude range of 20 km to 80 km have been obtained by the deployment of a blunt probe of Gerdien condenser sensor from a small meteorological rocket. The sensors are deployed from the rocket vehicle at apogee and descend subsonically from altitudes as great as 80 km down to 20 km. This report discusses the development of a data reduction technique for the analysis of atmospheric electrical conductivity utilizing a computer software program and hardware components. A comparison test of the improved computer reduction technique with prior manual/computer reduction method indicates the improved reduction technique results in data with greater accuracy and increases the data yield to higher altitudes. GRA

N81-17658# Northwestern Univ., Evanston, Ill.

LOWTRAN 6 SUBROUTINE FOR THE CALCULATION OF INTENSITY DEVIATION FOR POINT AND FINITE APER-

TURE RECEIVERS Final Report, 2 Jan. 1979 - 30 Jun. 1980
C. F. Ouyang, M. A. Plonus, and S. J. Wang Hanscom AFB, Mass. AFGL Sep. 1980 30 p refs
(Contract F19628-79-C-0068; AF Proj. 7670)
(AD-A094018; AFGL-TR-80-0297) Avail: NTIS HC A03/MF A01 CSCL 04/1

This report describes a coded subroutine for predicting atmospheric transmittance deviation due to the turbulence effect. This subroutine is designed to be used with LOWTRAN V. The calculation of transmittance deviation is for point receivers as well as for finite aperture receivers which exhibit the aperture averaging effect. GRA

N81-17659# Rice Inst., Houston, Tex.
STUDY OF MAGNETOSPHERIC CURRENTS AND RESULTANT SURFACE MAGNETIC VARIATIONS Final Report, 1 Oct. 1976 - 1 Feb. 1980
C. K. Chen, R. A. Wolf, M. Harel, J. L. Karty, R. W. Spiro, and G. M. Erickson Hanscom AFB, Mass. AFGL 17 Apr. 1980 82 p refs
(Contract F19628-77-C-0005; AF Proj. 2311)
(AD-A093928; AFGL-TR-80-0139) Avail: NTIS HC A05/MF A01 CSCL 04/1

Computer simulations were conducted for a substorm type event in the inner magnetosphere. Data from the Air Force S3-2 satellite and ground magnetometers were used for model inputs. Model predictions were analyzed and exhaustively compared with data from the S3-2 satellite, the AFGL magnetometer chain, and many other sources. Agreement between theory and data was very satisfactory in most respects. The model injected a realistic ring current during the substorm. T.M.

N81-17660# Columbia Univ., New York.
GRAVITY AND ACOUSTIC WAVES APPLIED TO THE DYAMICS AND KINEMATICS OF THE ATMOSPHERE Final Report, 15 May 1974 - 1 Nov. 1980
William L. Donn and Nambath K. Balachandran Dec. 1980 15 p refs
(Grants DAAG29-74-G-0172; DAAG29-77-G-0131)
(AD-A093713; ARO-12286.3-GS; ARO-14846.11-GS) Avail: NTIS HC A02/MF A01 CSCL 04/2

A generalized review of the work accomplished in the direct and spin-off areas supported over the past six years in the following areas is presented: (1) use of infrasound as an atmospheric probe: Infrasonic signals from natural and artificial sources were used as a passive probe of the atmosphere. (2) gravity wave program: In this study, an array of sensitive microbarographs (microbarovariographs) is used rather than microphones. Results so far show that surface gravity waves were related to the presence of wind shear aloft and often constitute continuous background perturbations. Gravity waves also shown to characterize the approach of warm fronts aloft, often well before the advent of precipitation and other storm features. Gravity waves were also shown to be of possible importance in generating thunderstorms through the triggering action at times unstable or conditionally unstable conditions. GRA

N81-17661# Weidlinger Associates, Menlo Park, Calif.
SITE-DEPENDENT GROUND MOTIONS FROM DISTANT EARTHQUAKES Final Report, Nov. 1979 - Sep. 1980
G. L. Wojcik, J. Isenberg, and W. S. Dunbar 30 Nov. 1980 95 p refs
(Contract F49620-80-C-0009; AF Proj. 2309)
(AD-A093791; R-8065; AFOSR-80-1377TR) Avail: NTIS HC A05/MF A01 CSCL 08/11

This study considers geologic and seismological reasons for patterns of guidance alarms in Minuteman Wing V due to the 1975 Pocatello Valley, Idaho and 1979 St. Elias, Alaska earthquakes. The main geologic feature identified that can produce the observed effect is the thickness of sediments overlying Precambrian basement rock. Near vertically-incident P and S seismic waves which propagate directly from the source through the crust and upper mantle can interact with this structure. A velocity model based on oil well log data and a Haskell-Thompson formulation for body wave propagation in a layered model indicate that amplitude of peak ground shaking can vary by a factor of 2 at adjacent Wing V Flights due to variations in sediment thickness and wavespeeds. Interaction of surface waves with the same sedimentary layer is currently being studied and is the subject of a forthcoming report. Escarpments, basin edges and similar features are not likely to cause the observed distribution of alarms because they produce resonances at periods too short to affect the Missile Guidance Set. GRA

N81-17662# Power Conversion Technology, Inc., San Diego, Calif.
STATUS OF LABORATORY EXPERIMENTS IN SEARCH OF THERMAL INSTABILITIES
Apr. 1980 25 p refs
(Contract DE-AC03-79ER-10341)
(PCT-11-78/RI-80) Avail: NTIS HC A02/MF A01

A microwave system for diagnosing simulated atmospheric plasmas is described. The plasma is formed by pulse ionizing a typically 5 torr helium argon gas with a 100 keV electron beam. DOE

N81-17663# Cologne Univ. (West Germany). Inst. fuer Geophysik und Meteorologie.
OZONE-RELATED INVESTIGATIONS USING A SIMPLE, FILTERSPECTROMETER [OZONBEZOGENE UNTERSUCHUNGEN MIT EINEM EINFACHEN FILTERSPEKTROMETER]
H. Neuhoff 1979 58 p refs In GERMAN; ENGLISH summary
(Mitt-27; ISSN-0069-5882) Avail: NTIS HC A04/MF A01

Ozone-related investigations with a simple, filter-equipped photometer are described. The instrument measures the intensity of skylight at 110 different points which are uniformly distributed over the hemisphere within 11 vertical scans. The photomultiplier output is digitized and registered on a punched tape. The spectral bands of the interference filters were selected in such a way that measurements are taken at 320 nm (high absorption by ozone) and 360 nm (low absorption). The total amount of ozone is derived from the ratio of the intensities at 360 nm and 320 nm within the solar vertical. The filterphotometer was calibrated by comparison with the Dobson-Spectrophotometer; calibration curves are shown both for cloudless and overcast skies. By insertion of polarization filters, the degree of polarization within the solar vertical for some selected azimuths was determined. As the degree of polarization is dependent on the turbidity of the atmosphere, the influence of dust extinction on the ozone measurements is inferred.
Author (ESA)

N81-17664# Graz Univ. (Austria). Inst. fuer Nachrichtentechnik und Wellenausbreitung.
THE EXPERIMENT FOR MEASUREMENT OF LOW ENERGY PROTONS IN THE ROCKET PAYLOADS SUBSTORM PHENOMENA AND PORCUPINE [DAS EXPERIMENT ZUR MESSUNG VON NIEDERENERGETISCHEN PROTONEN IN DEN RAKETENNUZLASTEN 'TEILSTURMPHAENOMENE' UND 'PORCUPINE']
A. Urban Jan. 1979 79 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(INW-7901) Avail: NTIS HC A05/MF A01

The physics of the magnetosphere are discussed in terms of the scientific aims of the IMS rocket campaigns. Emphasis is on phenomenology accounting for magnetic substorms. A particle experiment used to investigate the pitch angle distribution of protons in the energy range 0.5 to 30 keV is described. Three electrostatic analyzers are employed for the selection of the energies and directions, while channel electron multipliers served as detectors. The necessary calibration procedures for postlaunch data reduction are described and some results from flights are presented together with the associated substorm conditions seen at the time. Author (ESA)

N81-17665# Graz Univ. (Austria). Inst. fuer Nachrictentechnik und Wellenausbreitung.
BALLOON-BORNE MEASUREMENT AS PART OF MAGNETOSPHERE RESEARCH [BALLONGETRAGENE MESSUNGEN ZUR UNTERSUCHUNG DER MAGNETOSPHAERE]
H. Slamanig, K. M. Torkar, W. Riedler, and I. A. Zhulin

(Academgorodok) Dec. 1979 75 p refs In GERMAN; ENGLISH summary
(INW-7912) Avail: NTIS HC A04/MF A01

Balloon-borne measurement instrumentation, data relay to ground stations, and data processing as part of the logistics of the balloon campaign are described. In support of magnetosphere research, pressure and temperature profiles are obtained along with data on electric fields and the energy spectra of X-ray radiation. Direction and amplitude of E field vectors are calculated. The registration of rapid geomagnetic, pulsations, using a fast Fourier analysis is explained. Author (ESA)

N81-17666# Prakla-Seismos G.m.b.H., Hannover (West Germany).
THE QUALITY OF THE IMAGE IN SEISMIC HOLOGRAPHY Final Report
Karsten H. K. Koehler Bonn Bundesministerium fuer Forschung und Technologie Jun. 1980 139 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-79-112; ISSN-0340-7608) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 29,20

Seismic imaging, known as migration, used frequently for constructing images of the geologic structures in the subsurface from seismic measurements was studied. The expected defects in the image were calculated for the example of a point spread function, then verified for synthetic sections, model seismic records, and for a sample section taken from hydrocarbon prospecting. Rules for the relationship between aperture and the broadness of the diffraction image for the influence of weighting and for the premissible point spacing in the survey were derived. It is shown that a weighting is necessary, especially with 3D migration in order to avoid fictitious horizons in the resulting section. Author (ESA)

N81-17667# National Geodetic Survey, Rockville, Md.
CRUSTAL MOVEMENT INVESTIGATIONS AT TEJON RANCH, CALIFORNIA
Richard A. Snay and Michael W. Cline Jun. 1980 49 p refs
(PB81-119000; NOAA-TR-NOS-87; NGS-18;
NOAA-80091903) Avail: NTIS HC A03/MF A01 CSCL 08K

From 1964 to 1978, the National Geodetic Survey observed during 10 epochs two small and recently interconnected networks, RANCH and TEJON, which span two branches of the Garlock fault in California's Tehachapi Mountains. The 10 epochs of data, simultaneously adjusted using the least-squares methods and with the faults mathematically modeled, show that the horizontal crustal motion has varied nonlinearly with respect to time. The southern branch of the Garlock fault, spanned by the RANCH network, exhibited left-lateral strike slip and dip slip corresponding to normal faulting. Subsidence measured by vertical observations at this branch indicates that the fault dips southerly. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N81-17668*# Universities Space Research Association, Boulder, Colo.
WARM/COLD CLOUD PROCESSES Final Progress Report, 1 Jul. 1980 - 31 Oct. 1980
M. H. Davis 20 Jan. 1981 71 p refs
(Contract NAS8-33131)
(NASA-CR-161633) Avail: NTIS HC A04/MF A01 CSCL 04B

Final development of a gravimetric test for performance evaluation of a precision saturator is described. The design and development of a prototype droplet levitation chamber is discussed. Technical assistance to the MSFC Airborne Laser Doppler Program is reported. T.M.

N81-17669# Manchester Coll. of Science and Technology (England). Dept. of Physics.
CORONA FROM ICE, THUNDERSTORM ELECTRIFICATION AND LIGHTNING SUPPRESSION Final Report, 1 Sep. 1977 - 31 Aug. 1980
J. Latham Nov. 1980 19 p
(Grant AF-AFOSR-3429-77; AF Proj. 2310)
(AD-A093128; AFOSR-80-1285TR) Avail: NTIS HC A02/MF A01 CSCL 04/1

Five distinct avenues of research relating to thunderstorm electrification are presented: Airborne Studies of Thunderstorm Electrification details some results of the three-year Thunderstorm Research International Project (TRIP); Charge Transfer Accompanying Collisions Between Hailstones and Supercooled Raindrops in the Presence of an Electric Field; Charge Transfer Accompanying Individual Collisions Between Ice Particles. Surface Potential Steps and Their Role in Thunderstorm Electrification; The Growth of a Positive Streamer System; Laboratory and Theoretical Studies of the Raingush Phenomenon. The last four sections above are summaries of laboratory experiments conducted at the University of Manchester Institute of Science and Technology. GRA

N81-17670# Naval Oceanography Command Center/Joint Typhoon Warning Center, Guam.
AN EVALUATION OF THE DVORAK TECHNIQUE FOR ESTIMATING TROPICAL CYCLONE INTENSITIES FROM SATELLITE IMAGERY
J. D. Shewchuk and R. C. Weir Jul. 1980 28 p refs
(AD-A093278; NOCC/JTWC-TM-80-2) Avail: NTIS HC A03/MF A01 CSCL 04/2

This paper investigates the accuracy of tropical cyclone intensity estimates as derived from the Dvorak technique. Estimates of current intensity and 24 hour forecast intensities were verified against JTWC official best track data. Results from a 396 case sample indicate overall absolute and bias errors of less than one CI number, even though forecast intensity errors were twice that of the current intensity estimates. Comparison of Dvorak and JTWC intensity errors indicate that they are essentially equal. The Dvorak 24 hour forecast intensities are also superior to all objective forecast aids available to the JTWC. Dvorak forecast data were also evaluated as a function of the tropical cyclone's life cycle. Results show a tendency of the Dvorak technique to over-forecast developing and weakening trends. Verification of cases which included a PLUS or MINUS symbol indicated no improvement over cases with no symbols. However, the use of the symbols is believed to reduce forecast intensity error. GRA

N81-17671# Air Force Environmental Technical Applications Center, Scott AFB, Ill.
THE RANK INPUT METHOD AND PROBABILITY VARIATION GUIDES
Albert R. Boehm Jul. 1980 13 p refs
(AD-A093196; AD-E850006; USAFETAC/TN-80/004) Avail: NTIS HC A02/MF A01 CSCL 04/2

The rank input method allows a forecaster's subjective estimate to be quantified into a probability forecast. The forecaster's estimate can be a rank input, a probability of a single category, or a categorical forecast. With the rank input the forecaster ranks the synoptic situation--very bad to very good--in relation to the element to be forecast, e.g., surface visibility. The transnormalized regression probability model is then used to calculate the probability of the specific event. Probability of a single category can be converted to probabilities for one or more different categories. A categorical forecast can be converted to probability forecasts. A validation during REFORGER 78 concluded that the method shows promise and that forecasters were able to produce a large number of probability forecasts with a few simple rankings of the synoptic situation. Probability variation guides are tables giving forecast probability values for various inputs. Plotted on a simple graph, all values for a given skill and climatology fall along a single curve in probability space. These curves make certain decision analysis theorems much simpler in form. GRA

N81-17672# Federal Aviation Administration, Atlantic City, N.J.
EVALUATION OF AN ANEMOMETER CALIBRATOR FOR THE LOW-LEVEL WIND SHEAR ALERT SYSTEM Final Report, 6 Jan. - 26 Jun. 1980
Peter V. Versage Oct. 1980 18 p

(FAA Proj. 154-452-820)
(AD-A093141; FAA-CT-80-48; FAA-RD-80-118) Avail: NTIS HC A02/MF A01 CSCL 04/2

This effort was directed toward the evaluation of a Belfort calibration test stand which has been designed and manufactured for calibrating the Belfort type N wind vector transmitters being used at operational airports for the Low-Level Wind Shear Alert System (LLWAS). Results indicate that the calibration test stand allows accurate calibration of the wind vector transmitter (anemometer), but some improvement in design is recommended before quantity procurement is considered. GRA

N81-17673# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
STUDIES OF EXTRATROPICAL CYCLONIC STORMS (THE CYCLES PROJECT) Final Technical Report
Peter V. Hobbs 31 Oct. 1980 9 p refs
(Contract F49620-77-C-0057; AF Proj. 2310)
(AD-A092911; AFOSR-80-1279TR) Avail: NTIS HC A02/MF A01 CSCL 04/2

The organization of mesoscale rainbands with respect to synoptic fronts in extratropical cyclones is described. Airflow patterns, microphysical structures, and precipitation producing mechanisms in various rainbands have been documented. GRA

N81-17674# Committee on Tidal Hydraulics (Army), Washington, D.C.
EVALUATION OF NUMERICAL STORM SURGE MODELS Final Report
Dec. 1980 87 p refs
(AD-A093760; CTH-TB-21) Avail: NTIS HC A05/MF A01 CSCL 08/8

Federal services that minimize loss of life and property due to tropical hurricanes include forecasts and flood warnings. Because of the different concerns of these agencies their models have evolved in different ways and are applied with different input data, and apparent disparities have appeared. Evaluation was accomplished by having each modeling group separately exercise its models for selected past events and by comparing the model outputs with each other and with observed water elevations. Open-coast storm surge models were evaluated, then inland flooding models were evaluated using as input one of the open-coast model results. Each model tested included features that offered important advantages. Further, the models were continually evolving to include improved descriptions of the land and waters and of storms. No one model's predictions consistently gave better comparisons with observed data, however; and it is unlikely that one will be clearly better than the others for Corps purposes. GRA

N81-17675# Illinois State Water Survey, Urbana.
OUTFLOW FROM A NOCTURNAL THUNDERSTORM
Robert W. Scott Nov. 1980 34 p refs
(Grant NSF ATM-78-08865)
(AD-A093796; SWS-CR-242; TR-315; ARO-15529.5-GS) Avail: NTIS HC A03/MF A01 CSCL 04/2

An investigation of a dry nocturnal gust front moving over a dense network of meteorological instruments in east central Illinois is presented. The outflow was generated out of an eastward moving, organized storm system passing north of the network. Although no precipitation was measured in the network, a change from ambient to outflow air was observed in other meteorological parameters more than 100 km south of the point at which the outflow is estimated to have initiated. GRA

N81-17676# Illinois State Water Survey, Urbana.
BOUNDARY LAYER STRUCTURE AND ITS RELATION TO PRECIPITATION OVER THE ST. LOUIS AREA
Gary L. Achtemeier Oct. 1980 240 p refs
(Grant NSF ATM-78-08865)
(AD-A093795; SWS-CR-241; TR-2; ARO-15529.4-GS) Avail: NTIS HC A11/MF A01 CSCL 04/2

Rainfall, wind and temperature data at the surface and winds in the lower 1-2 km for a mesoscale area surrounding St. Louis, Missouri, for 7 summer days in 1975 were used in a study to determine the relationship between the surface kinematic fields and the occurrence and intensity of rainfall, and to determine if the surface kinematic fields are representative of the subcloud layer. It was found that, on some case days, patterns of convergence collocated favorably with raincells, were predictive of rainfall onset, and were positively related with rainfall amount. However, the relationships were nonexistent or negative on other case days. The statistics support the premise of the predictability of rain amount or rain mass based upon the preceding convergence on the cell scale and on the scale of the network, especially if some method that stratifies the convergence-rainfall relations can be found. Subsynoptic and/or mesoscale disturbances that tend to increase the potential for convective precipitation were present on all 7 case study days. These disturbances formed over the dense St. Louis surface network on three case study days. Although occurring under different synoptic conditions, these systems were similar structurally, being strongest near the surface and extending through a depth of 550 to 750 meters. GRA

N81-17677# Nevada Univ., Reno. Desert Research Inst.
CHARACTERISTICS OF ATMOSPHERIC ICE PARTICLES: A SURVEY OF TECHNIQUES Final Report, Jan. - Sep. 1980
John Hallett Hanscom AFB, Mass. AFGL Sep. 1980 62 p refs
(Contract F19628-80-C-0054; AF Proj. 2310)
(AD-A093927; AFGL-TR-80-0308) Avail: NTIS HC A04/MF A01 CSCL 04/2

A survey is given of properties of ice particles in the atmosphere necessary to assess the design of aircraft instrumentation required for their characterization. A critical review is given of current aircraft instrumentation from the view point of representative data acquisition in a realistic time frame, in particular techniques for mass and size distribution are examined. It is concluded that two as yet untried techniques utilizing particle accretion and evaporation show promise for measurement of mass distribution. GRA

N81-17678# Photometrics, Inc., Lexington, Mass.
DIGITALIZATION AND ANALYSIS OF PHOTOGRAPHIC IMAGES OF STRATOSPHERIC SMOKE TRAILS Final Report, 1 Sep. 1978 - 30 Jun. 1980
Christian A. Trowbridge Hanscom AFB, Mass. AFGL 30 Jul. 1980 28 p refs
(Contract F19628-78-C-0227; AF Proj. 6687)
(AD-A093926; PHM-02-80; AFGL-TR-80-0230) Avail: NTIS HC A03/MF A01 CSCL 04/2

A program of determination of horizontal wind profiles in the stratosphere is described. Photographic records of sunlight-scattering smoke trail tracers released from rockets were digitized, with the film plane coordinates of the trail centers recorded for input to a computer program that calculates spatial locations of sequences of trail points by vector triangulation. Star field photographs provided highly accurate camera orientations for calibration of the triangulation program. Reconstructed three dimensional trail positions as a function of time were processed to provide horizontal winds and vertical shear at approximately 10 meter vertical resolution. GRA

N81-17679# Systems Control, Inc., Palo Alto, Calif.
VORTEX MODELING Annual Progress Report, Oct. 1979 - Oct. 1980
Francis H. Nicholson Oct. 1980 26 p refs
(Contract N00014-80-C-0026)
(AD-A093793; SCI-5344-AR-01) Avail: NTIS HC A03/MF A01 CSCL 04/2

A full numerical model of the typhoon with rigid constraints on the divergence, vorticity and surface pressure fields was tested and found capable of producing realistic forecasts of typhoon development. The constraints on these fields are that the fields are subject to Laplace's equation in both spiral and circular cylindrical coordinates. The zero Laplacian constraint is compatible with a full scale model of the typhoon. Experiments on the role of the Richardson number, critical entrophy and eddy viscosity show their necessity in the creation and maintenance of the separate typhoon regimes. The asymmetric contributions account for the major portion of the divergence and vorticity budgets. New numerical techniques which bypass finite differencing account for significant reduction in storage requirements and in computational time. GRA

N81-17680# Systems and Applied Sciences Corp., Riverdale, Md.
COMPUTER-BASED WEATHER RESEARCH Scientific Report, 1 Dec. 1978 - 30 Nov. 1979
Alan M. Gerlach 29 Feb. 1980 86 p
(Contract F19628-79-C-0033; AF Proj. 6670)
(AD-A094020; AFGL-TR-80-0069) Avail: NTIS HC A05/MF A01 CSCL 04/2

This report details meteorological research conducted by Systems and Applied Sciences Corporation in several areas: development of a limited-area Numerical Weather Prediction model; comparative test of wind sets; development of mesoscale forecasting software for McIDAS; improvement in satellite data brightness analysis techniques. Also, McIDAS hardware and software capabilities were upgraded and used to support field research activities. GRA

N81-17681# Department of Energy, Washington, D. C. Office of Energy Research.
INTRODUCTION TO METEOROLOGICAL MEASUREMENTS AND DATA HANDLING FOR SOLAR ENERGY APPLICATIONS
Oct. 1980 219 p refs
(DOE/ER-0084) Avail: NTIS HC A10/MF A01

Five project areas, called tasks, were identified for cooperative activities within the IEA Program to Develop and Test Solar Heating and Cooling Systems. The objective of one task was to obtain improved basic resource information for the design and operation of solar heating and cooling systems through a better understanding of the required insolation (solar radiation) and related weather data, and through improved techniques for measurement and evaluation of such data. At the February 1976 initial experts meeting in Norrkoeping, Sweden, the participants developed the objective statement into two subtasks: (1) an insolation handbook; and (2) a portable meteorological instrument package. The handbook provides a basis for a dialogue between solar scientists and meteorologists. DOE

N81-17682# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
INCLUSION OF ROUTINE WIND AND TURBULENCE FORECASTS IN THE SAVANNAH RIVER PLANT'S EMERGENCY RESPONSE CAPABILITIES
M. M. Pendergast and D. B. Gilhousen (National Weather Service, Silver Spring, Md.) 1980 18 p refs Presented at Symp. of Intermediate-Range Atmospheric Transport Processes and Technol. Assessment, Gatlinburg, Tenn., 1 Oct. 1980 Submitted for publication
(Contract DE-AC09-76SR-00001)
(DP-MS-80-52; CONF-801064-1) Avail: NTIS HC A02/MF A01

The Savannah River Plant's emergency response computer system was improved by the implementation of automatic forecasts of wind and turbulence for periods up to 30 hours. The forecasts include wind direction, wind speed, and horizontal and vertical turbulence intensity at 10, 91, and 243 m above ground for the SRP area, and were obtained by using the model output statistics (MOS) technique. A technique was developed and tested to use the 30 hour MOS forecasts of wind and turbulence issued twice daily from the National Weather Service at Suitland, Maryland, into SRP's emergency response program. The technique for combining MOS forecasts, persistence, and adjusted MOS forecast is used to generate good forecasts any time of day. Wind speed and turbulence forecasts have been shown to produce smaller root mean square errors (RMSE) than forecasts of persistence for time periods over about two hours. For wind direction, the adjusted MOS forecasts produce smaller RMSE than persistence for times greater than four hours. Author

N81-17683# *National Weather Service, Sterling, Va. Test and Evaluation Div.*
PRECISION OF NATIONAL WEATHER SERVICE UPPER AIR MEASUREMENTS
Walter E. Hoehne Aug. 1980 30 p refs
(PB81-108136; NOAA-TM-NWST-ED-16; NOAA-80082703)
Avail: NTIS HC A03/MF A01 CSCL 05B

The functional precision of upper air measurements was determined by comparing measurements made simultaneously by two radiosondes attached to the same balloon and tracked by two radiotheodolites. Functional precision is a measure of the reproducibility of a measurement and is defined as the root mean square (rms) of the measuring systems. The data for this determination were obtained from 50 weekly balloon flights. The results were compared to results of a similar determination made in 1973 before recent changes in the measurement process. Comparisons were made at 300 m height increments and 10 mb pressure increments in addition to the simultaneous comparisons. GRA

N81-17684# Water and Power Resources Service, Denver, Colo. Engineering and Research Center.
WIND RESOURCE OF THE AREA SURROUNDING MEDICINE BOW, WYOMING
Aug. 1980 39 p refs
(PB81-109621) Avail: NTIS HC A03/MF A01 CSCL 04B

Five high wind sites were instrumented to record wind resource data, with the ultimate goal of installing a large number of wind turbine generators, i.e., establishing a windfarm. Integration of windpower and hydroelectric power are accomplished by tying the windfarm output into an existing hydropower electrical grid. The data is presented in the form of plots of monthly mean windspeed, duration windspeed exceeded, windspeed frequency, and polar wind roses. GRA

N81-17685# National Severe Storms Lab., Norman, Okla.
THE RELATIONSHIP OF THE 300 MB JET STREAM TO TORNADO OCCURRENCE
Carolyn M. Kloth and Robert P. Jones-Davies Jul. 1980 75 p refs
(PB81-118960; NOAA-TM-ERL-NSSL-88) Avail: NTIS HC A04/MF A01 CSCL 04B

The relationship between the upper tropospheric jet streams and tornado occurrence was examined. The 300 mb wind field over the United States was analyzed and parameters such as divergence, relative vorticity, horizontal wind shear, and positive vorticity advection were computed. The data revealed that tornadoes generally occurred beneath stronger than average 300 mb winds of 15 to 30 m/s, within 1250 km of a 35 to 55 m/s jet streak, beneath the left front or right rear quadrant of the jet streak, and were generally of F0 or F1 intensity. Four days were examined in detail in an effort to discover how and why the tornado situations differed. The strength and combination of the 300 mb parameters influenced tornado intensity and the pattern of tornado events. GRA

N81-17686# National Hurricane and Experimental Meteorology Lab., Coral Gables, Fla.
CLASSIFICATION OF METEOROLOGICAL RADAR ECHOES BY THEIR STATE OF MOTION DURING FACE (FLORIDA AREA CUMULUS EXPERIMENT) 1970 - 1978. PROCEDURES AND RESULTS
Francis J. Merceret (Research Facilities Center), Ronald L. Holle, and John B. Cunning Jul. 1980 14 p
(PB81-113383; NOAA-TR-ERL-441; NHEML-3) Avail: NTIS HC A02/MF A01 CSCL 04B

The procedure applies a set of objective rules for interpreting radar film. The eight rules and the reasons for their formulation are presented. The results of the application of this scheme to radar data from operational days during the Florida Area Cumulus Experiment (FACE) are presented, discussed, and compared with the results from the previous procedure of classification. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N81-17687# *Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.*
BATHYMETRIC DATA REDUCTION SUBSYSTEM (BDRS)
John Lanier, Gordon Frank, and James P. Moron Dec. 1980 30 p refs
(AD-A093747) Avail: NTIS HC A03/MF A01 CSCL 08/10

The Bathymetric Data Reduction Subsystem (BDRS) represents a new concept in bathymetric data reduction processing. The BDRS is the primary support subsystem to the Bathymetric Information System (BIS). BIS is one of eight interactive data base systems to be developed under a global control system known as the Source Data Base System (SODS). SODS will provide users with both centralized access and information manipulation capability to these various information systems, including BIS. Users will have no direct access to BDRS, but they will be able to retrieve information from BIS through SODS. Through the use of various software programs the BDRS accepts digital data input from analog sources and magnetic tape. Output from the system will consist of proof plots, track-line generation, data base access and editing, and 'quick look' capabilities into the database. New developments contained in the system are: voice recognition digitization system which allows the input of sounding data by spoken word; digitization of fathograms and the subsequent proof-plot generation using ship's log and the digitized soundings; and, the ability to geo-section portions of the data base using circular, triangular, or polygonic searches to define user areas of interest. GRA

N81-17688# Naval Ocean Research and Development Activity, Bay St. Louis, Miss. Sea Floor Div.

AN APPROACH TO THE QUANTITATIVE STUDY OF SEA FLOOR TOPOGRAPHY

J. E. Matthews Jan. 1980 69 p refs

(AD-A093702; NORDA-TN-47) Avail: NTIS HC A04/MF A01 CSCL 08/10

This report represents an assessment of sea floor and sub-sea floor relief as related to acoustic bottom interaction. Marine topography, whose amplitude spans six orders of magnitude, is here divided into three broad categories: (1) features likely to cause propagation blockage, (2) features which act as sloping bottoms, and (3) features which act as acoustic scatterers. Maps of the North Atlantic and North Pacific Oceans are presented which delimit the areas where each of these three categories would be expected to dominate propagation. GRA

N81-17689# Naval Postgraduate School, Monterey, Calif.

MICROPLANKTONIC ATP-BIOMASS AND GTP-PROTECTIVITY ASSOCIATED WITH UPWELLING OFF PT. SUE, CALIFORNIA M.S. Thesis

Sherman Hughes Bronsink Sep. 1980 71 p refs Sponsored by Navy

(AD-A093585) Avail: NTIS HC A04/MF A01 CSCL 08/1

Microplanktonic ATP-biomass and GTP-productivity were studied in upwelling features off Pt. Sur, California. Biomass, determined by adenosine triphosphate (ATP) and chlorophyll a, was found to have a definite preferential location in the strong gradients of temperature and nutrients on the equatorward edge of the feature. Productivity, as sampled using the new method of guanosine triphosphate (GTP) sampling was found to be high throughout the thermo-nutrient gradient associated with an upwelling feature in an early stage of development. The measurement of productivity and 'growth potential' using GTP and GTP/ATP ratios was found to be a valuable tool in examining rapidly changing upwelling features. Preliminary results obtained using the GTP technique suggests a relationship between the flux of nutrients across ocean fronts and planktonic productivity associated with frontogenic coastal upwelling systems. GRA

N81-17690# Lamont-Doherty Geological Inst., Palisades, N. Y.

TRANSPORT AND TRANSFER RATES IN THE WATERS OF THE CONTINENTAL SHELF Annual Report

P. E. Biscaye Sep. 1980 237 p refs

(Contract DE-AS02-76EV-02185)

(COO-2185-13) Avail: NTIS HC A11/MF A01

The transport and dispersal processes of energy-related pollutants introduced to the waters of the continental shelf and slope were studied. The report is divided into sections dealing with processes associated with suspended solids; processes associated with sediments sinks for radionuclides and other pollutants; and spreading of water characteristics and species in solution. DOE

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N81-17691*# California Univ., Irvine. Dept. of Developmental and Cell Biology.

DEVELOPMENT OF GUAYULE (PARTHENIUM ARGENTATUM) RESEARCH IN CELL CULTURE Final Report

Ernest A. Ball 1 Jan. 1981 14 p refs Prepared for JPL

(Contracts NAS7-100; JPL-954955)

(NASA-CR-163945; UCI-59913) Avail: NTIS HC A02/MF A01 CSCL 06C

Utilizing the lateral buds of known high rubber producing plants as explants in culture medium specifically designed to engender shoot development and to prevent callus formation, unlimited numbers of replicate plants can be produced. Each has the same genotype as the parent. This procedure has long been used to rid plants of virus, the latter generally does not occur in the embryonic tissues of the bud; it also, by virtue of its axenic nature, eliminates all microorganisms characteristic of the parent plant. Auxins were found essential to callus formation, but since the latter is known to bring about chromosomal aberrations, it was avoided. The cytokinin benzylaminopurine strongly stimulated shoot growth, and the number of regenerated buds on the inoculum was proportional to its concentration. These buds produced shoots several centimeters in length which were caused to root on medium containing indolebutyric acid. Transferred to the septic condition of soil, the plantlets were gradually brought into full sunlight where they showed a brief vegetative growth with production of mature leaves, and flowered. Author

N81-17692*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

USE OF AN ELECTRICAL RESISTANCE HYGROMETER TO MEASURE HUMAN SWEAT RATES

Toshiyuki Suga Oct. 1980 30 p refs

(NASA-TM-81223; A-8306) Avail: NTIS HC A03/MF A01 CSCL 06P

The application of the resistance hygrometer as a tool to measure the localized sweat rate from the human body in both the active and passive sweat regions was studied. It was found that the physiological function of the skin membrane and fluid carrier transport phenomena from the outer skin have an indistinguishable effect on the observed findings from the instrument. The problems associated with the resistance hygrometer technique are identified and the usage of the instrument in the physiological experimentation from the engineering standpoint is evaluated. Author

N81-17693# Academy of Natural Sciences of Philadelphia, Pa. Div. of Limnology and Ecology.

PHYTOPLANKTON STUDIES AND NUTRIENT CONCENTRATIONS IN THE VICINITY OF THE C. P. CRANE GENERATING STATION Final Report, Jul. 1979 - Mar. 1980

K. C. Sellner, L. A. Lyons, R. K. Mahoney, M. M. Olson, and E. S. Perry 17 Sep. 1980 75 p refs Sponsored by Maryland Dept. of Natural Resources

(PB81-114746; PPSP-CPC-80-5) Avail: NTIS HC A04/MF A01 CSCL 06F

Plant operations appeared to stimulate phytoplankton productivity at plant discharge and in upper Saltpeter Creek. Carbon fixation rates and assimulation ratios were enhanced in wholewater and nanoplankton size fractions for the three upper Saltpeter Creek stations compared to data collected at intake (Seneca Creek). However, few significant alterations in phytoplankton biomass (chlorophyll alpha) resulting plant operations were noted in the vicinty of the C.P. Crane plant. Enhanced productivities were probably a function of ambient water temperature, Delta Ts observed between intake and the impacted areas and species composition of the phytoplankton. GRA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N81-17694* National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY. A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 214

1981 71 p

(NASA-SP-7011(214)) Avail: NASA Scientific and Technical Information Facility, P.O. Box. 8757, B.W.I. Airport, Md. 21240 CSCL 06E

This bibliography lists 140 reports, articles, and other documents introduced into the NASA scientific and technical information system in December 1980. A.R.H.

N81-17695# Army Research Inst. of Environmental Medicine, Natick, Mass. Military Ergonomics Div.

PHYSIOLOGICAL AND HEMATOLOGICAL RESPONSES TO SUMMER AND WINTER DRY-HEAT ACCLIMATION

Yair Shapiro, Roger W. Hubbard, Claire M. Kimbrough, and Kent B. Pandolf 25 Jul. 1980 35 p refs

(AD-A093194; USARIEM-M-31/80) Avail: NTIS HC A03/MF A01 CSCL 06/19

Differences between acclimation to heat at the end of winter (W) and at the end of summer (S) were studied on the same 8 male volunteers. Subjects were exposed to 40 C, 30% rh for 10 days on two separate occasions approximately 5 months apart (S and W). Daily exposures lasted 120 min: 10 min rest, 50 min walking 1.34m/s on the level, 10 min rest, 50 min walking. During W acclimation, rectal temperature (Tre) and heart rate (HR) decreased, sweat rate (msw) remained unchanged, and plasma and red cell volume of the blood expanded. During S acclimation, HR decreased while Tre and msw remained unchanged, and plasma volume increased. The Tre of the acclimated subjects remained higher in W and msw lower than in S. It was concluded that acclimation does not totally eliminate the seasonal differences in thermoregulatory set-point and sweat sensitivity. Further, acclimation to a more severe heat did not improve the thermoregulatory set-point that was achieved by natural acclimatization to a milder heat, but affected the cardiovascular adjustment and caused greater plasma volume expansion. W acclimation caused both plasma and blood cell volume expansion while S acclimation affected only plasma volume. GRA

N81-17696# Army Research Inst. of Environmental Medicine, Natick, Mass.

THERMAL COMFORT IN AN ERA OF ENERGY SHORTAGE

Ralph F. Goldman 6 Oct. 1980 27 p refs

(AD-A093193; USARIEM-M-30/80) Avail: NTIS HC A03/MF A01 CSCL 15/5

Human thermal comfort rests upon the interactions among six ket factors: four from the environment and two regulated by the individual and his job. The four ambient environmental factors include air temperature, air motion, vapor pressure, and the mean radiant temperature of the surroundings. Heat production and clothing are the individual factors. The correlation of these factors were studied and the results for office environments are presented. T.M.

N81-17697# Connecticut Univ., Storrs.

TOXICOLOGY AND METABOLISM OF NICKEL COMPOUNDS: COMPREHENSIVE REPORT OF OVERALL ACTIVITIES DURING THE THREE-YEAR PERIOD FROM 1 DECEMBER 1977 - 30 NOVEMBER 1980

F. W. Sunderman, Jr. 15 Aug. 1980 18 p refs

(Contract DE-AS02-76EV-03140)

(DOE/EV-03140/5-T1) Avail: NTIS HC A02/MF A01

The principal areas of investigation were: embryotoxicity, teratogenicity, and mutagenicity of nickel carbonyl; metabolism, detoxification, and excretion of nickel compounds; studies of nickel carcinogenesis; nickel anlaysis in body fluids and tissues to monitor occupational exposures; and nephrotoxicity of nickel compounds. The hematological effects of nickel compounds were also examined. DOE

N81-17698# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

SPATIAL DISORIENTATION IN FLIGHT: CURRENT PROBLEMS

G. Perdriel, ed. (French Air Force, Paris) and A. J. Benson, ed. (RAF, Farnborough, England) Oct. 1980 99 p refs In ENGLISH and FRENCH Proc. of Conf. held in Bodo, Norway, 20-23 May 1980

(AGARD-CP-287; ISBN-92-835-0278-7) Avail: NTIS HC A05/MF A01

The correlation between spatial disorientation in flight and the occurrance of aircraft accidents is discussed in detail. Particular attention is placed on determining the perceptual errors that characterize spatial disorientation in flight. For individual titles, see N81-17699 through N81-17709.

N81-17699# Centre de Recherches du Service de Sante des Armees, Clamart (France).

PHYSIOLOGICAL MECHANISMS OF SPATIAL DISORIENTATION NOT OF VISUAL ORIGIN [LES MECHANISMS PHYSIOLOGIQUES DE LA DESORIENTATION SPATIALE D'ORIGINE NON VISUELLE]

J. Colin *In* AGARD Spatial Disorientation in Flight Oct. 1980 6 p refs In FRENCH (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

Spatial orientation involves the complex integration of data emanating from numerous receptors. In most cases, a disorientation occurs when the visual system, which plays the principle role, can no longer perform its function and the other systems are influenced by a gravito-inertial environment. The reactions thrown out of gear by linear and radial acceleration and then by angular acceleration are reviewed. For a third time the factors modifying the intensity of these reactions are recalled. This permits insisting on the concept of visual dominance and vestibular suppression, which is at the origin of the essential means of preventing spatial disorientation in flight. An aeromedical formation of the crew is particularly important in the visual presentation of information required for piloting, for repeated carry over for flight formation and for flight without visibility. Transl. by A.R.H.

N81-17700# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

AN UPDATE OF FINDINGS REGARDING SPATIAL DISORIENTATION IN FLIGHT: A RECONSIDERATION OF UNDERLYING MECHANISMS

F. H. Monesi *In its* Spatial Disorientation in Flight Oct. 1980 6 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

The anatomical foundations, physiological mechanisms and mental functions known to influence spatial orientation on Earth and in flight are reviewed. The effects of flight environment on visual, vestibular and kiaesthetic cues as well as on mental functions able to induce perceptual errors conducive to spatial disorientation are reconsidered with a view of identifying the theories accounting for disorientation incidents and accidents in flight. R.C.T.

N81-17701# Italian Air Force Medical Services, Bari-Palese AFB.

PERCENTUAL ERRORS IN FLIGHT: A SURVEY OF 100 MILITARY PILOTS ON ACTIVE DUTY

Pietro DeGiosa *In* AGARD Spatial Disorientation in Flight Oct. 1980 7 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

A survey was given to 80 pilots and 20 cadet pilots in flight activity to determine some of the problems associated with perceptive disturbances in flight. The survey consisted of 116 questions, divided into 6 major parts: the first contains biographical data such as age, total hours of flight and the hours of flight activity during 1979, type of aircraft piloted, flight accident if any; the second part is relative to the possible correlation between on the one hand psycho-affective or psycho-social situation and type of mission and on the other hand disturbances if any; the third part refers to the correlation

between on the one hand physical conditions, life, habits, the use of drugs and on the other hand possible perceptive alterations they can cause; the fourth part investigates the relations between the type of aircrafts and perceptive alterations; the fifth part deals with different atmospheric conditions in which the flight is possible; with some of the questions we investigate the duration of the disturbances and the time of the disappearance of these perceptive disturbances initially felt; and the last part investigates the perceptive disturbances suffered out of the flight and the quality considered indispensable in avoiding them. R.C.T.

N81-17702# Pennsylvania State Univ., University Park.

THE AMBIENT VISUAL SYSTEM AND SPATIAL ORIENTATION

H. W. Liebowitz and J. Dichgans (Tuebingen Univ.) *In* AGARD Spatial Disorientation in Flight Oct. 1980 4 p refs (For primary document see N81-17698 08-52)

(Grants MH-08061; EY-03276)

Avail: NTIS HC A05/MF A01

Two modes of processing visual information are reviewed with particular emphasis on their independent functions and the role of the ambient visual system in orientation. The multisensory basis of orientation and the central integration of signals are discussed. Disorientation is assumed to result from a mismatch, in comparison with the previous experience of the individual, of these simultaneously occurring signal patterns. It is suggested that disorientation in aircraft under instrument flight conditions may result from the substitution of an unnatural symbolic indicator to replace the visual stimuli normally involved in orientation and the failure of a learned cognitive skill to compensate for mismatched signals. R.C.T.

N81-17703# School of Aerospace Medicine, Brooks AFB, Tex. Ophthalmology Branch.

VISUAL ILLUSIONS AS A PROBABLE CAUSE OF AIRCRAFT ACCIDENTS

Thomas J. Tredici *In* AGARD Spatial Disorientation in Flight Oct. 1980 5 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

Spatial disorientation, visual restrictions, and illusions were examined as the possible causal factors in aircraft accidents. A number of aircraft accidents were analyzed in which visual illusions appear to be a significant or contributing factor in the accident. It is shown that such factors as rain on the windshield, flashblindness by high intensity strobe lights, disorientation by flickering lights, and ground light intensity variations appear to have led to errors in judgement, thus directly contributing to the aircraft accident. It is concluded that a studied awareness of these factors is the pilot's best corrective action available. R.C.T.

N81-17704# Army Air Corps, Stockbridge (England).

DISORIENTATION IN ARMY HELICOPTER OPERATIONS: A GENERAL REVIEW

K. Edgingtom and C. J. Box *In* AGARD Spatial Disorientation in Flight Oct. 1980 9 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

Accidents involving aircraft mishandled during takeoff, landing or tactical low flying (or nap of the earth flight) were investigated. Special emphasis was placed on examining those accidents which occurred as a result of flight disorientation. Orientation error rates, the type of accidents as well as influencing factors were reviewed. Significant results are reported. R.C.T.

N81-17705# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Lab. de Medecine Aerospatiale.

ILLUSIONS OF ATTITUDE AND MOVEMENT DURING EARTH-HORIZONTAL ROTATION

Alain Leger, Jack P. Landolt, and Kenneth E. Money *In* AGARD Spatial Disorientation in Flight Oct. 1980 19 p refs In ENGLISH and FRENCH Prepared in cooperation with Defence and Civil Inst. of Environmental Medicine, Downsview, Ontario (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

Ten voluntary males underwent a sequence of experiments to determine the effect of rotation about the horizontal axis. Each subject underwent nine separate tests of rotation about the horizontal axis. The number of tests was determined by the number of combinations of the three subject axes (X, Y and Z) and three visual conditions (no visual reference, internal visual reference, and external visual reference). In the first condition, the subject was in total darkness (NVR). The internal visual reference (IVR) was produced by lighting the interior of the gondola. Finally, In the external visual reference (EVR) condition, the gondola hatch was left open and the subject could see the surrounding laboratory, with a visual field of about 60 X 50 deg. The order of tests for each subject was determined by a nine by nine Latin square. In spite of the strong visual input, convincing illusions of attitude and movement were found in the IVR condition. Similar illusions, of course, were experienced in the NVR condition. Comparable illusions occurred during the X-axis and Y-axis rotations, as well as during the (usually employed) Z-axis rotations. In most subjects, the illusions were absent in the EVR condition, but, in some subjects, there was perceptible illusory movement inspite of clear visual reference to the real motion. R.C.T.

N81-17706# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

ORTHOSTATIC DISORDER. A CONTRIBUTING FACTOR TO MOTION SICKNESS?

G. R. Froehlich *In* AGARD Spatial Disorientation in Flight Oct. 1980 4 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

Pilot candidates were subjected to the vestibular adroitness test to determine the effects of orthostatic disorders on motion sickness. The test consisted of bending the head once 60 degrees downward and back to the upright position while being rotated at 180 degrees/sec. The test was divided into four categories; each category producing a varying degree of motion sickness symptoms (i.e., mild nausea to severe nausea). Significant results as well as the conclusions are presented in detail. R.C.T.

N81-17707# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Head/Biodynamics Section.

A GENERALIZED TRANSFER FUNCTION FOR DESCRIBING MECHANONEURAL SEMICIRCULAR-CANAL DYNAMICS

Jack P. Landolt (Texas Univ., Galveston) and Manning J. Correia *In* AGARD Spatial Disorientation in Flight Oct. 1980 10 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

The dynamic response characteristics of the semicircular canal to rotational head movements were determined via a generalized transfer function. The adequacy of the model was tested by recording the neural activity of the primary efferent fibers inervating the semicircular canals as they respond to appropriate stimulation. Specifically the mechanoneural response characteristics of primary afferent, semicircular canal units in the pigeon were studied to determine whether the model could be used in describing the neurodynamics in other species. R.C.T.

N81-17708# Naval Aerospace Medical Research Lab., Pensacola, Fla.

A MULTISTATION SPATIAL DISORIENTATION DEMONSTRATOR

Fred E. Guedry, Jr. *In* AGARD Spatial Disorientation in Flight Oct. 1980 (P refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

A disorientation familiarization trainer was designed and constructed for demonstrating a range of visual and acceleratory conditions that induce disorientation. The demonstrator provides students with memorable personal experiences with various classes of disorientating conditions coupled with an introduction to disorientation-error prevention. R.C.T.

N81-17709# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

THE ROYAL AIR FORCE SPATIAL DISORIENTATION FAMILIARISATION DEVICES (SDFD)

A. J. Benson *In* AGARD Spatial Disorientation in Flight Oct. 1980 10 p refs (For primary document see N81-17698 08-52)

Avail: NTIS HC A05/MF A01

The Spatial Disorientation Familiarization Device (SDFD) was

designed to demonstrate to aircrew the fallibility of their senses and the errors of perception that can lead to spatial disorientation in flight. The SDFD is a servocontrolled turntable on which the subject is seated 1 m from the axis of rotation, inside a light-tight cab. Displays within the cab show the subject that his sensations of rotation and attitude are in error, and permit the demonstration of oculogyral, oculogravic, cross coupled (Coriolis) and autokinetic phenomena. Control of the velocity trajectory of the turntable and the illumination of the various displays may be preprogrammed and recorded along with a commentary on magnetic tape. This facility allows an optimized training sequence to be delivered consistently, even by relatively unskilled operators. R.C.T.

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N81-17710# Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany). Forschungsgesellschaft fuer Angewandte Naturwissenschaften e. V.

ON THE PRACTICE OF MEASURING SENSORY THRESHOLDS: SIGNAL DETECTION AND THE ADAPTIVE METHOD [ZUR PRAXIS DER WAHRNEHMUNGSSCHWELLENMESSUNG: SIGNALENTDECKUNGSANALYSE UND ADAPTIVE VERFAHREN]

S. Trispel May 1979 117 p refs In GERMAN; ENGLISH summary Prepared in cooperation with Helmholtz-Inst. fuer Biomed. Tech.

(FB-43) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Ger. DM 10

After an introduction to the principles of psychophysical threshold measurement, the fundamentals of signal detection theory and of adaptive measurement techniques, in each case confined to absolute threshold measurement, are discussed. Both procedures are compared regarding their practical usefulness and levels of significance. The application of both procedures is described for the same situation, subjects had to detect a step like velocity change (with a given a priori probability) of a horizontally moving object on a CRT screen. The results, gathered from relatively small groups of subjects, demonstrate in detail some of the inherent effects of these procedures. An adaptive, automatized test for visual acuity measurement is described as an example for the construction of an adaptive measurement strategy. Finally, the differences between both procedures as to their range of applications are considered. It is concluded that the results of signal detection analysis yield true threshold values, whereas results from adaptive experiments often are influenced by the employed adaptive logic. Author (ESA)

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N81-17711*# San Jose State Univ. Foundation, Calif.

MAGNITUDE OF VISUAL ACCOMMODATION TO A HEAD-UP DISPLAY

Edward F. Leitner and Richard F. Haines Feb. 1981 12 p refs

(NASA-TP-1796; A-8379; HUD-15) Avail: NTIS HC A02/MF A01 CSCL 01D

The virtual image symbology of head-up displays (HUDs) is presented at optical infinity to the pilot. This design feature is intended to help pilots maintain visual focus distance at optical infinity. However, the accommodation response could be nearer than optical infinity, due to an individual's dark focus response. Accommodation responses were measured of two age groups of airline pilots to: (1) static symbology on a HUD; (2) a landing site background at optical infinity; (3) the combination of the HUD symbology and the landing site background; and (4) complete darkness. Results indicate that magnitude of accommodation to HUD symbology, with and without the background, is not significantly different from an infinity focus response for either age group. The dark focus response is significantly closer than optical infinity for the younger pilots, but not the older pilots, a finding consistent with previous research. R.C.T.

N81-17712# DBA Systems, Inc., Lanham, Md. Research Inst.

DESIGNER'S GUIDE FOR THE PANEL PROGRAM Technical Interim Report

Medhat Korna and Nilss Aume Oct. 1980 68 p

(Contract F33615-78-C-0507; AF Proj. 7184)

(AD-A093989; UDR-TR-80-64; AMRL-TR-80-124) Avail: NTIS HC A04/MF A01 CSCL 09/2

This designer's guide describes an interactive computer graphics program intended for the computer aided design of avionics control and display panels. Using this program, a designer can specify the basic panel on which all other components will be mounted as well as the components themselves. Also, he can locate and relocate the components, add graphic elements (text, lines, circles), and call for printed, punched, or hard copy (plot) output. The requirements and considerations of several applicable MIL-STANDARDS have been incorporated into the program to facilitate the design process. The Guide to the operation of the PANEL program includes descriptions of the processing available for each of the program functions and subfunctions. A listing of the program is also included along with a brief description of most of the subroutines. GRA

N81-17713# General Electric Co., Syracuse, N.Y. Military Electronic Systems Operation.

COMPUTER-AIDED DEVELOPMENT OF CONTROL CONSOLE, CONTROL PANEL, AND DISPLAY USER INSTRUCTIONS AND TRAINING MATERIALS

S. A. Solow and W. O. Mills Oct. 1980 13 p

(AD-A093891; R80EMH9) Avail: NTIS HC A02/MF A01 CSCL 09/2

This technical information series (TIS) outlines a procedure for developing instructions and training materials for control panel operation and indicator and display interpretation. The method is particularly advantageous when the operator has to observe and respond to large amounts of data and manipulate many controls. The process is described in this TIS as it is applied to the preparation of information for the tactical towed array sonar (TACTAS) System Operator's Manual. However, it can be applied with slight modification to systems having similarly complex man-machine interfaces. Data input, storage, processing, and output are performed by the time-share subsystem (TSS) of the Honeywell 520 Data Processing System (level 66). GRA

N81-17714# Ingenieurbuero fuer Ergonomie, Munich (West Germany).

ERGONOMIC STUDY OF THE INFLUENCE OF ROTARY VIBRATIONS [ERGONOMISCHE UNTERSUCHUNGEN UEBER DIE EINWIRKUNG ROTATORISCHER SCHWINGUNGEN. BEANSPRUCHUNG DURCH ROLLSCHWINGUNGSBELASTUNG]

Wilhelm Ilgmann Bonn Bundesministerium fuer Verteididung 1979 133 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteididung

(BMVg-FBWT-79-33) Avail: NTIS HC A01/MF A01; DOKZENTBW, Bonn DM 40

For the measurement of the effects of sinusoidal rotary whole-body vibrations on man, a two-degree of freedom motion simulator for roll and pitch vibrations was designed and built. Using the method of producing stimuli ratios, roll vibration strain up to the tolerance limit was investigated in the frequency range from 1 to 10 Hz. Results demonstrate that the psychophysical law of Stevens is appropriate to describe the relationship between vibration stress and subjective sensation. Although the deviation between subjects is quite large, in the frequency range investigated the exponent of the psychophysical law is found to be constant. The correlation between subject's individual reaction and physiological data, such as weight and stature, is small. In consequence of the divergent results concerning the magnitude of sensation related to the same intensity level of vibration,

percentiles are recommended to set exposure limits.
Author (ESA)

N81-17715*# Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany). Forschungsgesellschaft fuer Angewandte Naturwissenschaften e. V.
MONITORING AND DECISION MAKING BY PEOPLE IN MAN MACHINE SYSTEMS [UEBERWACHUNGS- UND ENTSCHEIDUNGSVERHALTEN DES MENSCHEN IN MENSCH-MASCHINE-SYSTEMEN]
G. Johannsen May 1979 92 p refs Partly in GERMAN and ENGLISH
(Grant NSG-2119)
(NASA-CR-164026; FB-44) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10 CSCL 05H

The analysis of human monitoring and decision making behavior as well as its modeling are described. Classic and optimal control theoretical, monitoring models are surveyed. The relationship between attention allocation and eye movements is discussed. As an example of applications, the evaluation of predictor displays by means of the optimal control model is explained. Fault detection involving continuous signals and decision making behavior of a human operator engaged in fault diagnosis during different operation and maintenance situations are illustrated. Computer aided decision making is considered as a queueing problem. It is shown to what extent computer aids can be based on the state of human activity as measured by psychophysiological quantities. Finally, management information systems for different application areas are mentioned. The possibilities of mathematical modeling of human behavior in complex man machine systems are also critically assessed.
Author (ESA)

N81-17716# Office of Technology Assessment, Washington, D. C.
ENVIRONMENTAL CONTAMINANTS IN FOOD. VOLUME 2, PART B: WORKING PAPERS
Jan. 1980 557 p refs Sponsored by Office of Technology Assessment, Washington
(PB81-116774-Vol-2-Pt-B) Avail: NTIS HC A24/MF A01 CSCL 06F

The contents include: toxic substances in food information systems: design and management; assessment of carcinogenic risks from PCBs in food; economic analysis of alternative action levels in the regulation of environmental contaminants in food and analysis of foods for radioactivity. Approaches to monitoring environmental contaminants in food and analytical systems for the determination of metals in food and water supplies are described. Assessment of methods for regulating 'unavoidable' contaminants in the food supply and consumer risk from environmental contaminants in food were determined. GRA

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

N81-17717*# Ohio Univ., Athens. Dept. of Electrical Engineering.
BI-DIRECTIONAL COMMUNICATION INTERFACE FOR MICROPROCESSOR-TO-SYSTEM/370
Joseph P. Fischer Jan. 1981 24 p refs
(Grant NGR-36-009-017)
(NASA-CR-163940; TM-77) Avail: NTIS HC A02/MF A01 CSCL 09B

The design and operation of a bi-directional communication interface between a microcomputer and the IBM System/370 is documented. The hardware unit interconnects a modem to interface to the S/370, the microcomputer with an EIA I/O port, and a terminal for sending and receiving data from either the microcomputer or the S/370. Also described is the software necessary for the two-way interface. This interface is designed so that no modifications need to be made to the terminal, modem, or microcomputer. M.G.

N81-17718# TRW Defense and Space Systems Group, Redondo Beach, Calif.
FAST METHODOLOGY AND CASE STUDY Final Technical Report, 2 Feb. 1979 - 29 Aug. 1980
Griffiss AFB, N.Y. RADC Nov. 1980 221 p refs
(Contract F30602-79-C-0078; AF Proj. 5581; AF Proj. 3205)
(AD-A093680; RADC-TR-80-336) Avail: NTIS HC A10/MF A01 CSCL 09/2

This report describes work done to implement and validate the Flexible, Analysis, Simulation and Test methodology developed by TRW to perform hardware software tradeoff analysis for computer system design. The methodology, partially developed with TRW IR D funds, was tested by a case study analysis using the Defense Mapping Agency's Management Information System for Procurement (DMIS/P). GRA

N81-17719# Westinghouse Defense and Electronic Systems Center, Baltimore, Md.
CCD ANALOG PROGRAMMABLE MICROPROCESSOR (APUP) STUDY Final Technical Report, 21 Sep. 1978 - 15 Oct. 1979
Donald R. Lampe, I. A. Mack, J. D. Fogarty, S. J. Mederer, J. Mattern, and E. H. Naviasky Griffiss AFB, N.Y. RADC Aug. 1980 358 p refs
(Contract F30602-78-C-0315; AF Proj. 4506)
(AD-A093496; RADC-TR-80-276) Avail: NTIS HC A16/MF A01 CSCL 09/2

A cross-correlation of radar signal processing needs and CCD-compatible analog signal processing devices yielded a functional partitioning into several distinct candidates primarily on the basis of data storage time and data format. The azimuth processing function clearly preferred for implementation has two alternate architectures: the discrete correlation transform versus the two part combination of a corner-turn memory plus a transversal filter. The greater flexibility of the correlation transform scheme translates immediately into greater user acceptance, larger markets, and lower costs. The details of the transform/filter APUP candidate are given, including an ingenious new application of the traditional push/pull scheme to cancel even-harmonic distortion as well as offset fixed pattern noise arising from nonuniformities in thermal leakage or FET threshold. Also incorporated is a new additive refresh technique aimed at maintaining sample-to-sample isolation during multiple recirculation. GRA

N81-17720# Cincinnati Univ., Ohio. Dept. of Electrical and Computer Engineering.
A NEW MULTIPLIER STRUCTURE FOR DIGITAL SIGNAL PROCESSING Final Report
Fred J. Taylor 1980 168 p refs
(Contract F49620-79-C-0066; AF Proj. 2304)
(AD-A093430; AFOSR-80-1321TR) Avail: NTIS

HC A08/MF A01 CSCL 09/2

The charge of this grant was the study of a new class of memory intensive digital arithmetic units based on modular algebra. The new class of arithmetic units, developed under this grant, operate at very high speeds, admit VLSI and bit-slice realizations, and can be integrated into digital signal processing systems. GRA

N81-17721# General Electric Co., Pittsfield, Mass. Ordnance Systems.

ELECTRICAL CHARACTERIZATION OF MICROPROCESSORS AND THEIR SUPPORT CHIPS Final Technical Report, Apr. 1978 - May 1980

Barney W. Hajduk, Thomas M. Ostrowski, Donald Tucker, John Luzzi, and Lawrence Deluca Oct. 1980 91 p

(Contract F30602-78-C-0172; AF Proj. 2338)

(AD-A093216; RADC-TR-80-325) Avail: NTIS HC A05/MF A01 CSCL 09/2

The objective of this effort was to develop MIL-M-38510 slash sheets for microprocessors and their support devices. The report includes the technical analyses of manufacturer generated functional test program and the changes made to them. Four slash sheets (not included in this report) were developed. They are /460 for the 9900A, /443 for the 2909, /445 for the 2910, and /401 for the 6821. User and manufacturer comments to the /440 and /421, developed under a previous contract (Report RADC-TR-78-138), were reviewed with the manufacturers and changes were made to the slash sheets were required. GRA

N81-17722# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Computer Science.

TAPE DUMP AND RESTORE

Richard J. Orgass 28 Aug. 1980 21 p

(Grant AF-AFOSR-0021-79; AF Proj. 2304)

(AD-A093263; VPI/SU-TM-80-5; AFOSR-80-1291TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

A set of three programs to write CMS disk files on magnetic tape in a variety of formats suitable for reading or a variety of computing systems and for restoring these tape files to disk within the restrictions imposed by the University Computing Center is described. The documentation is partial because the author was unable to complete the document before leaving Virginia Tech. GRA

N81-17723# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Computer Science.

REAL-TIME TURING MACHINES UNDER VARYING SPECIFICATIONS

Paul M. B. Vitanyi Jul. 1980 33 p refs Submitted for publication

(MC-IW-140/80) Avail: NTIS HC A03/MF A01; Stichting Mathematische Centrum, Amsterdam FL 3

The relative computing power of Turing machines with differences in the number of tapes, heads per tape, and instruction repertoire, is studied. Included are the k-tape, k-head and k-head jump models as well as 2 way multihead (writing) finite automata with and without jumps. Differences in computing power between machines of unlike specifications emerge under the real time restriction. In particular it is shown that a (k+1)-head tape unit is more powerful than a k-head tape unit as a storage device for real time Turing machines, and that jumps add power to multihead 2 way real time finite automata. Author (ESA)

N81-17724# Siemens A.G., Munich (West Germany). Unternehmensbereich Bauelemente.

DEVELOPMENT OF MICROPROCESSOR SYSTEMS Final Report

Guenter Sandner, Irmfried Bromme, Guenther Eberhard, Heiz Ellwanger, Riyad Helow, Heinrich Kessler, Hans-Eberhard Longo, and Klaus Zibet Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 68 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-79-54; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 14,30

Development, manufacturing, and applications of highly integrated microprocessor and microcomputer IC components are surveyed. Projects reported on include: development of an n channel silicon gate MOS program for the 8 bit microprocessor family 8080, 8255, 8205, 8212, 8224, 8228, 8238; the definition of a multifunction universal asynchronous receiver transmitter IC; and the definition and IC development of a one chip microcomputer. The development and manufacturing of a microcomputer system based on the 8080 family are detailed. Activities in the area of 16 bit microprocessors, namely the 310 LSI (fixed instructions set), and the concept of the 3016, a microprogrammable CPU with integrated control store, are also covered. Author (ESA)

N81-17725# Ohio State Univ., Columbus. Research Foundation.

DEVELOPMENT OF A DATA LINK FROM PDP-77/34 COMPUTER TO HP 9830 CALCULATOR Final Report, Jul. 1979 - May 1980

H. Hemami and Scott L. Hendricks Feb. 1980 81 p refs

(Contract NHTSA-9-6607)

(PB81-105926; DOT-HS-805-552; TO-80-HH-054) Avail: NTIS HC A05/MF A01 CSCL 09B

The report discusses the design, construction, and use of a one-way data link between the PDP 11/34 Computer and HP 9830 calculator located at the Vehicle Research and Test Center (VTRC) of the National Highway Traffic Safety administration (NHTSA). The primary use of this one-way link will be the transmission of simulated crash data from the PDP 11 to the HP so it can be plotted using the equipment and software programs already available on the HP calculator. GRA

N81-17726# Network Analysis Corp., Vienna, Va.

MICROCOMPUTER INTERFACING STANDARDS SURVEY ANALYSIS Final Report

8 Aug. 1980 205 p

(Contract NB79-SBCA-0209)

(PB81-105868) Avail: NTIS HC A10/MF A01 CSCL 09B

The development of standards for microcomputer interfacing is discussed. Three interface bus categories are identified and existing and potential candidate standards are examined. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N81-17727# Harvard Univ., Cambridge, Mass. Center for Research in Computing Technology.

REFINEMENT OF AN ABSTRACT MODEL OF MSG Technical Report, 1 Oct. 1978 - 31 Dec. 1979

William R. Bush Apr. 1980 25 p refs

(Contract N00039-78-G-0020; ARPA Order 3079)

(AD-A092969) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report describes the second phase of an experiment designed to demonstrate techniques for software development and evolution. The experiment involves the production of a family of functionally similar systems on dissimilar host computers with markedly different operating systems. The basic technique used is machine-assisted stepwise refinement from an abstract model program that embodies the desired characteristics of the family members without overconstraining the individual implementations. GRA

N81-17728# National Bureau of Standards, Washington, D.C.

GUIDELINES FOR EXCHANGEABLE APT DATA PACKAGES, APT PART PROGRAMMERS MANUAL Final Report

Bradford M. Smith Jun. 1980 26 p

(AD-A092929; NBSIR-80-2073-2) Avail: NTIS HC A03/MF A01 CSCL 09/2

A method of APT programming and postprocessor design has been developed which permits more efficient data preparation for numerical control (NC) machine tools and then allows this data to be quickly and easily exchanged among different NC machines. This is accomplished through rigorous specification of the APT post-processor language based upon new ANSI standards for APT plus a comprehensive definition of the machining

functions which should result from the use of each APT language statement. Individual post-processors are modified to process each statement in the same manner. The concept was successfully demonstrated in production by processing a single APT data package on three different milling-drilling type machine tools. A 23% increase in NC manufacturing efficiency is projected. This document describes the APT post-processor language used, including the syntax and semantics of each statement. It also defines the default conditions under which the post-processor and machine tool operator accomplish the desired function in the absence of the automatic feature. GRA

N81-17729# National Bureau of Standards, Washington, D.C.
GUIDELINES FOR EXCHANGEABLE APT DATA PACKAGES: APT POSTPROCESSOR SPECIFICATIONS Final Report
Bradford M. Smith Jun. 1980 15 p refs
(AD-A092933; NBSIR-80-2073-3) Avail: NTIS HC A02/MF A01 CSCL 09/2

A method of APT programming and postprocessor design has been developed which permits more efficient data preparation for numerical control (NC) machine tools and then allows this data to be quickly and easily exchanged among different NC machines. This is accomplished through rigorous specification of the APT post-processor language based upon new ANSI standards for APT plus a comprehensive definition of the machining functions which should result from the use of each APT language statement. Individual postprocessors are modified to process each statement in the same manner. This document sets forth minimum specifications for the procurement of APT Postprocessors consistent with the standardized postprocessing language concept. It is expected that these specifications will be used in future machine tool procurements. The concept was successfully demonstrated in production by processing a single APT data package on three different milling-drilling type machine tools. A 23% increase in NC manufacturing efficiency is projected. GRA

N81-17730# Texas Univ. at Austin. Center for Cybernetic Studies.
A PRIMAL SIMPLEX CODE FOR COMPUTING THE EFFICIENCY OF DECISION MAKING UNITS (VERSION 2.0)
Authella Bessent and Jeff Kennington (Southern Methodist Univ., Dallas, Tex.) Oct. 1980 18 p refs Prepared in cooperation with Carnegie Mellon Univ., Pittsburgh
(Contracts N00014-80-C-0242; N00014-76-C-0932)
(AD-A092962; CCS-383) Avail: NTIS HC A02/MF A01 CSCL 12/1

This technical report describes the computer code (Version 2.0 of SMU1) developed to compute the efficiency of a set of decision making units (DMU's) with common inputs and outputs. The code, written in FORTRAN and tested on a CDC Cyber 73 using an MNF compiler, employs a modified primal simplex code. A sample of the computer generated solution is included. GRA

N81-17731# Yale Univ., New Haven, Conn. Dept. of Computer Science.
RETRIEVAL AND ORGANIZATIONAL STRATEGIES IN CONCEPTUAL MEMORY: A COMPUTER MODEL
Janet Lynne Kolodner Nov. 1980 261 p refs
(Contract N00014-75-C-1111; Grant NSF IST-79-18463)
(AD-A093084; PR-187) Avail: NTIS HC A12/MF A01 CSCL 09/2

People effortlessly recall past events and episodes in their lives many times in the course of a normal day. A reasonable goal in the design of computer programs is to construct a memory with that same capability. To facilitate human-like retrieval of events from a computer memory, we must first specify a reasonable memory organization. We must then design updating and retrieval processes to build up and access that information. This thesis will present such a theory, and will describe a computer program called CYRUS which implements that theory. CYRUS (Computerized Yale Retrieval and Updating System) stores and retrieves episodes in the lives of Secretaries of State Cyrus Vance and Edmund Muskie. When new events are added to its memory, CYRUS integrates them into memory along with the events it already knows about. CYRUS can then answer questions posed to it in English about the events it stores. The algorithms and memory organization used in CYRUS have been developed by examining the way people answer questions requiring extensive memory search. Its reconstructive processes include instantiation strategies, which construct and elaborate on contexts for search, and search strategies, which direct construction. GRA

N81-17732# Science Applications, Inc., Englewood, Colo.
THE PROCESSES INVOLVED IN DESIGNING SOFTWARE
Michael E. Atwood, Robin Jeffries, Althea A. Turner, and Peter G. Polson Aug. 1980 62 p refs Prepared in cooperation with Colorado Univ., Boulder
(Contract N00014-78-C-0165; NR Proj. 157-414; RR0420602)
(AD-A092935; SAI-80-110-DEN) Avail: NTIS HC A04/MF A01 CSCL 09/2

A design task involves a complex set of processes. Starting from a global statement of the problem, a designer must develop a precise plan for a solution that can be realized in some concrete way. Software design, which is investigated in this paper, is the process of translating a set of task requirements into a structural description of a computer program that will perform the task. Through experience, designers acquire knowledge concerning the overall structure of a good design and of the processes of generating one. Using this knowledge, they direct their actions to insure that their designs will satisfy these constraints. We call this abstract knowledge about designs and design processes, along with a set of procedures which implement these processes, a 'design schema'. This paper describes the design schema of experienced software designers and illustrates its operation by considering thinking-aloud protocols collected from both expert and novice designers. GRA

N81-17733# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
PHANTOM STACKS, IF YOU LOOK TOO HARD THEY AREN'T THERE
Richard M. Stallman 16 Jul. 1980 14 p refs
(Contract N00014-75-C-0643)
(AD-A093189; AI-M-556) Avail: NTIS HC A02/MF A01 CSCL 09/2

A stack is a very efficient way of allocating and deallocating memory, but it works only with a restricted pattern of usage. Garbage collection is completely flexible but comparatively costly. The implementation of powerful control structures naturally uses memory which usually fits in with stack allocation but must have the flexibility to do otherwise from time to time. How can we manage memory which only once in a while violates stack restrictions without paying a price the rest of the time? This paper provides an extremely simple way of doing so, in which only the part of the system which actually uses the stack needs to know anything about the stack. We call them Phantom Stacks because they are liable to vanish if subjected to close scrutiny. Phantom Stacks will be used in the next version of the Artificial Intelligence Lab's Scheme microprocessor chip. GRA

N81-17734# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
EMACS MANUAL FOR ITS USERS
Richard M. Stallman 8 Jun. 1980 220 p
(Contract N00014-75-C-0643)
(AD-A093186; AI-M-554) Avail: NTIS HC A10/MF A01 CSCL 09/2

This manual documents the use and simple customization of the display editor EMACS with the ITS operating system. The reader is not expected to be a programmer. Even simple customizations do not require programming skill, but the user who is not interested in customizing can ignore the scattered customization hints. This is primarily a reference manual, but can also be used as a primer. GRA

N81-17735# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences.
PROVIDING AUTOMATIC GRAPHIC DISPLAYS THROUGH DEFAULTS Technical Report, Apr. 1980 - Mar. 1981
Sakunthala Gananmgari, N. I. Badler, H. L. Morgan, and Bonnie L. Webber Apr. 1980 9 p refs
(Contracts N00014-75-C-0462; MDA903-80-C-0093; NR Proj. 049-272)

(AD-A093398; Rept-80-03-09) Avail: NTIS HC A02/MF A01 CSCL 09/2

This paper addresses the problems in providing graphic displays automatically to serve a user naive with respect to computer graphic devices. It identifies the properties of data that affect graphic representation and presents a formalism in which to view them. It also discusses and illustrates the selection of various graphic formats based on the data to be represented, its properties, and graphic device characteristics. GRA

N81-17736# Cornell Univ., Ithaca, N. Y. Dept. of Computer Science.

ON EDGE COLORING BIPARTITE GRAPHS

R. Cole and J. Hopcroft Nov. 1980 12 p refs

(Contract N00014-76-C-0018)

(AD-A093097; CU-CSD-TR-80-443) Avail: NTIS HC A02/MF A01 CSCL 09/2

An algorithm for finding a minimal edge coloring of a bipartite graph in time O(E log V) is presented. Polynomial time algorithms for this problem have previously been given by Gabow and Kariv the best time bounds being O(E log sq V) and O(V sq log V). The algorithm is based on using fast methods for finding maximal matchings in semiregular bipartite graphs; an algorithm for finding a maximal matching in a general bipartite graph was given by Hopcroft and Karp. Two algorithms for finding such a matching are given. Although the second one always has a faster running time, the first one is presented for the sake of clarity. GRA

N81-17737# Naval Postgraduate School, Monterey, Calif.

AUTOMATIC IDENTIFICATION OF NETWORK ROWS IN LARGE-SCALE OPTIMIZATION MODELS M.S. Thesis

William Gordon Wright Sep. 1980 52 p refs

(AD-A093256) Avail: NTIS HC A04/MF A01 CSCL 12/1

The solution of contemporary large-scale linear, integer, and mixed integer programming problems is often facilitated by the exploitation of intrinsic special structure in the model. This paper deals with the problem of identifying embedded pure network rows within the coefficient matrix of such models and presents two heuristic algorithms for identifying such structure. The problem of identifying the maximum size embedded pure network is shown to be among the class of NP-hard problems, therefore, the polynomially-bounded algorithms presented here do not guarantee network sets of maximum size. However, upper bounds on the size of the maximum network set are developed and used to evaluate the algorithms. Finally, the algorithms were tested with a number of large-scale, real-world models and the results of these benchmark runs are presented. GRA

N81-17738# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Reference System Branch.

SOFE: A GENERALIZED DIGITAL SIMULATION FOR OPTIMAL FILTER EVALUATION USER'S MANUAL Final Report, 1 Jan. 1976 - 31 Jul. 1980

Staton H. Musick Oct. 1980 189 p refs

(AF Proj. 1206)

(AD-A093887; AFWAL-TR-80-1108) Avail: NTIS HC A09/MF A01 CSCL 09/2

This report describes a general-purpose program that was developed to help design and evaluate Kalman filters for integrated systems. The program, which is named SOFE, is a Monte Carlo simulation that can be used for system performance analysis once the Kalman filter is designed and verified. SOFE is written in FORTRAN and is intended for batch use on a digital computer. This report is a complete user's manual for SOFE. It documents the equations used, the program structure, the input requirements and output options, and concludes with examples of SOFE use in both linear and nonlinear (extended) Kalman filter design studies. SOFE is divided into two modules named basic SOFE and user-written SOFE. Basic SOFE accomplishes all of the usual bookkeeping and integration functions of a Monte Carlo simulation (see below) and, in addition, provides the algorithm for measurement update of the user's filter. As its name implies, user-written SOFE is a module of FORTRAN-coded subroutines supplied by the user. These routines specify the system under study, including both truth and filter components. The rationale for this division, which places the constant routines in basic SOFE and the variable routines in user-written SOFE, is to free the designer to concentrate on more central issues including problem definition, model specification, model validation, and insight acceleration through experimentation. The 31 routines of basic SOFE perform I/O (including printer plots), problem setup, run setup, numerical integration of the ordinary differential equations that specify the system dynamics, measurement update, run termination and problem termination. GRA

N81-17739# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

VALID INEQUALITIES FOR 0-1 PROGRAMMING POLYTOPES

Egon Balas and Joseph B. Mazzola Nov. 1980 24 p refs

(Contract N00014-75-C-0621; Grant NSF ECS-79-02506; NR Proj. 047-048)

(AD-A093963; MSRR-468) Avail: NTIS HC A02/MF A01 CSCL 12/1

We introduce a family of valid inequalities for 0-1 programming polytopes that are typically not implied by individual problem constraints or by proper subsets of the full constraint set. The computational effort involved in generating such an inequality is linear in the number of variables and in the number of constraints. Several procedures are known in the literature for generating valid inequalities for, or facets of, knapsack polytopes, i.e., 0-1 programming polytopes with a single constraint. Although these inequalities are usually stronger than the corresponding Gomory cuts, since they make use of the binary nature of the variables, their strength is still limited by the fact that they are derived from single constraints. The inequalities introduced here can be viewed as generalizations to the multi-constraint case of the inequalities derived for the knapsack polytope. GRA

N81-17740# Michigan Univ., Ann Arbor. Systems Engineering Lab.

A BLOCK-ORIENTED EQUATION SOLVER FOR THE CRAY-1 Interim Report

D. A. Calahan 1 Dec. 1980 38 p refs

(Grant AF-AFOSR-0158-80; AF Proj. 2304)

(AD-A093874; AFOSR-80-0158TR; AFOSR-80-1375TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes algorithms, applications, and use of a general block-oriented sparse equation solver for a memory-hierarchial, functionally current vector processor, the CRAY-1. GRA

N81-17741# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Computer Science Branch.

METRICS OF SOFTWARE QUALITY Final Report, 1 Jun. 1977 - 30 Oct. 1980

Zygmund Jelinski, P. B. Moranda, and J. B. Churchwell Nov. 1980 142 p refs

(Contract F49620-77-C-0099; AF Proj. 2304)

(AD-A093788; MDC-G9326; AFOSR-80-1376TR) Avail: NTIS HC A07/MF A01 CSCL 09/2

This report covers the period from 1 June 1977 to 30 October 1980. A major task on this contract was to make a comprehensive review of the literature on software metrics and of quantitative measures of program testing. Another accomplishment was the development of an automatic procedure for testing FORTRAN programs with random numbers and random symbols. This procedure first drives the program with sets of random data, then senses the tracks taken, compares each generated track against all predecessors, then on the basis of the pattern of occurrence of new tracks, provides an estimate of the total number of residual paths. Additional sets of random numbers can be then generated. The program developed to instrument a given FORTRAN program and provide data for evaluating coverage is described in the Final Report of earlier work (MDC G6553, dated December 1976). Changes which have been made are described herein. In the related topics of Software Reliability, two methods of estimating the residual error content of an entire program on the basis of data obtained in the testing of portions of it have been developed and are detailed here. GRA

N81-17742# Stanford Univ., Calif. Systems Optimization Lab.

A NUMERICAL INVESTIGATION OF ELLIPSOID ALGORITHMS FOR LARGE-SCALE LINEAR PROGRAMMING

Philip E. Gill, Walter Murray, Michael A. Saunders, and Margaret H. Wright Oct. 1980 27 p refs Presented at the Workshop on Large-scale Linear Programming, Laxenburg, Austria, 2-6 Jun. 1980
(Contracts DAAG29-79-C-0110; N00014-75-C-0267; DE-AC03-76SF-00326; DE-AT03-76ER-72018; Grants NSF MCS-79-26009; NSF ENG-77-06761)
(AD-A093617; SU-SOL-80-27) Avail: NTIS HC A03/MF A01 CSCL 12/1

The ellipsoid algorithm associated with Shor, Khachiyan and others has certain theoretical properties that suggest its use as a linear programming algorithm. Some of the practical difficulties are investigated here. A variant of the ellipsoid update is first developed, to take advantage of the range constraints that often occur in linear programs (i.e., constraints of the form l + or - aTx + or - u, where u - l is reasonably small). Methods for storing the ellipsoid matrix are then discussed for both dense and sparse problems. In the large-scale case, a major difficulty is that the desired ellipsoid cannot be represented compactly throughout an arbitrary number of iterations. Some schemes are suggested for economizing on storage, but any guarantee of convergence is effectively lost. At this stage there remains little room for optimism that an ellipsoid-based algorithm could complete with the simplex method on problems with a large number of variables. GRA

N81-17743# PRC Information Sciences Co., McLean, Va.
RASTER TO LINEAL CONVERSION SOFTWARE Final Technical Report, 18 Jun. 1979 - 15 Aug. 1980
Susan L. Farrance Oct. 1980 59 p
(Contract F30602-79-C-0150; AF Proj. 4303)
(AD-A093490; PRC-R-3266; RADC-TR-80-324) Avail: NTIS HC A04/MF A01 CSCL 09/2

The purpose of the Raster of Lineal Conversion Software is to produce lineal feature files from data which has been digitized by raster scanning of the cartographic source. The particular objectives of this effort are to identify and correct shortcomings of the existing Raster to Lineal Conversion Software, and, secondly, to design and implement output modules to provide multiple output formats to facilitate editing of manuscripts. GRA

N81-17744# Army Construction Engineering Research Lab., Champaign, Ill.
AUTOMATED DOCUMENTATION SYSTEM (ADS) STUB GENERATOR: DESCRIPTION AND USER INSTRUCTIONS Final Report
Linda Lawrie and Jean Baugh Oct. 1980 40 p refs
(AD-A093153; CERL-TR-E-167) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes a subsystem of the Automated Documentation System (ADS) called the Stub Generator. The Stub Generator lets software development managers define which ADS documentation sections must be in the final software code. It also lets the manager monitor updated ADS documentation as initial software codes are amended and extended. The programmer is given a convenient way of developing a system in a top-down structural manner through the generation of standard program stubs. GRA

N81-17745# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences.
AN IMPLEMENTATION TECHNIQUE FOR DATABASE QUERY LANGUAGES Technical Report, Apr. 1980 - Mar. 1981
Peter Buneman, Robert E. Frankel, and Rishiyur Nikil Jun. 1980 58 p refs
(Contract N00014-75-C-0462)
(AD-A093397; Rept-80-06-06) Avail: NTIS HC A04/MF A01 CSCL 09/2

Structured query languages, such as those available for relational databases, are becoming increasingly desirable for all database management systems. Such languages are applicative: there is no need for an assignment or update statement. A new technique is described that allows for the implementation of applicative query languages against most commonly used database systems. GRA

N81-17746# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences.
THE USE OF DATA TYPE INFORMATION IN AN INTERACTIVE DATABASE ENVIRONMENT Technical Report, Apr. 1980 - Apr. 1981
Peter Buneman and Ira Winston Nov. 1980 11 p refs
(Contract N00014-75-C-0462)
(AD-A093441; Rept-80-11-08) Avail: NTIS HC A02/MF A01 CSCL 09/2

Despite the enormous advances that have been made in the specification of data types and data models in the fields of programming languages, databases and artificial intelligence; there remain a number of problems in attempting to unify the various approaches to the formal description of data. The purpose of this brief paper is to examine these problems from the point (or points) of view of those people -- designers, administrators, applications programmers, and end-users -- whose main interest is with databases. In particular, we hope to display special concern for the tools provided for the end-user, who should be the final beneficiary of whatever advances are made. GRA

N81-17747# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences.
A CODASYL INTERFACE FOR PASCAL AND ADA Technical Report, Apr. 1980 - Mar. 1981
Peter Buneman, Larry Menten, and David Root (International Data Base Systems, Philadelphia) Nov. 1980 22 p refs
(Contract N00014-75-C-0462)
(AD-A093440; Rept-80-11-07) Avail: NTIS HC A02/MF A01 CSCL 09/2

A CODASYL interface has been constructed for PASCAL and designed for ADA that exploits the data type systems of these languages. We believe that the form of this interface will simplify the writing of CODASYL applications and greatly reduce errors in coding. In particular, it relieves the user from the need to consider data currency and global data areas and uses the host language's type system to perform many checks at compile-time that in other interfaces can at best be done at run-time. GRA

N81-17748# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Computer Science.
FILES IN AN INTERACTIVE ENVIRONMENT
Richard J. Orgass 1 Apr. 1980 12 p ref
(Grant AF-AFOSR-0021-79; AF Proj. 2304)
(AD-A093261; VPI/SU-TM-80-3; AFOSR-80-1289TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

A well designed file system can significantly simplify the design of and increase the reliability of interactive programs. A summary of the specifications of a convenient file system that is substantially independent of the host operating system and some experiences using the system are described. GRA

N81-17749# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Computer Science.
LIBSIM: AN EXTENSION OF THE SIMULA LIBRARY
Richard J. Orgass 28 Aug. 1980 18 p refs
(Grant AF-AFOSR-0021-79; AF Proj. 2304)
(AD-A093262; VPI/SU-TM-80-4; AFOSR-80-1290TR)
Copyright. Avail: Issuing Activity CSCL 09/2

The DEC-10 SIMULA library contains a number of procedures that are not available in the IBM SIMULA library. A subset of these procedures as well as approximations to procedures in class SAFEIO (distributed with DEC-10 SIMULA) have been implemented for use with IBM SIMULA and collected in a TXTLIB. This report describes these procedures and gives directions for accessing and using the procedures. GRA

N81-17750# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Computer Science.
SIMULA (TRADEMARK) FILE CLASSES Interim Report
Richard J. Orgass 8 Oct. 1980 48 p
(Grant AF-AFOSR-0021-79; AF Proj. 2304)
(AD-A093264; VPI/SU-TM-80-6; AFOSR-80-1293TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

Two SIMULA Class in file and out file which are designed as replacements for the system defined classes in file and Out file in IBM SIMULA are described. These replacements provide

a number of capabilities that make it easier to work with a terminal in interactive programs and provide for considerably improved error recovery. GRA

N81-17751# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Computer Science.
[INTERACTIVE PROGRAM VERIFICATION] Final Scientific Report
Richard J. Orgass 22 Nov. 1980 15 p refs
(Grant AF-AFOSR-0021-79; AF Proj. 2304)
(AD-A093265; VPI/SU-TM-80-7; AFOSR-80-1292TR) Avail: NTIS HC A02/MF A01

The main emphasis of grant work was bringing software that was reliably working on a DEC System 10 into reliable operation on the Virginia Tech VM/CMS system. This work is best viewed as preparation for the substantial work of the grant. Work was also directed toward achieving two objectives: (1) Modify an incremental program verification system to accept APL programs. The main work here was to isolate code in the verifier that is specific to the syntax of the programming language in which the programs were written in a single SIMULA class so that is could be easily modified for different languages. (2) Completing the implementation of an APL expression evaluator based on a formal semantics of APL and verifying this implementation with respect to the formal semantics. During this period, the objective was to complete a verified implementation of an APL epxression evaluator and to have an interactive verifier for APL expressions working correctly by about August 15, 1980. These two pieces of software were then to be used to conduct a number of experiments that would aid in the design of a verifier for all of APL. GRA

N81-17752# National Physical Lab., Teddington (England). Computer Services Unit.
A SIMPLE ALGORITHM FOR DRAWING A CURVE THROUGH A SET OF POINTS
B. R. Heap Dec. 1979 33 p refs
(NPL-CSU-4/79) Avail: NTIS HC A03/MF A01

The algorithms which form the basis of the graph and curve routines currently implemented on an ICL KDF9 computer are presented. Three types of curve are distinguished: a single function, a multi-valued open ended curve, and a multi-valued closed curve. The problems of drawing smooth curves through a set of points and drawing a smooth single valued graph with an incremental plotter are reviewed. A list of the routines which are available in the graphics software section of the library is included.
Author (ESA)

N81-17753# Oxford Univ. (England). Dept. of Engineering Science.
CAL 1979
O. L. R. Jacobs, A. J. F. Hodgson, and D. W. Clarke 1979 29 p
(OUEL-1300/79) Avail: NTIS HC A03/MF A01

User manual information is presented for five computer assisted instruction programs: (1) Program BEAMS which draws shear force and bending moment diagrams for statically determinate beams subject to transverse loads; (2) program ANTENA which draws the far-field radiation pattern of a linear array of isotropic radiators; (3) program LOGICAL which simulates logic networks and gives graphical output in the form of circuit diagrams and time histories of variables; (4) a program for computer sided design of linear feedback systems which mechanizes routine graphical design procedures of classical control theory; (5) program ESMP which simulates a large analog computer. All the packages are interactive, written in FORTRAN and run from on a PDP 11/45 under multiuser IAS system. BEAMS requires a terminal with a current (TX 4010).
Author (ESA)

N81-17754# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Numerical Analysis and Computing Science.
A SIMPLE APPROACH TO RELATIONAL ALGEBRA QUERY LANGUAGE DESIGN
Stefan Amborg 1980 18 p refs
(TRITA-NA-8002) Avail: NTIS HC A02/MF A01

A design process for a query language based on relational algebra is described. Some key principles applied were: make explicit assumptions about the end users background; delimit the scope of the language; and avoid conceptual innovations as far as possible. The language designed closely mirrors concepts from elementary algebra and set theory and contains no join or relational division, although it is relationally complete. The only significant innovation in the query language context is a hierarchical tuple structure similar to the record hierarchy of COBOL and PASCAL, a mechanism for defining functions on the tuples of a relation, used for restriction, generalized projection and quantification. Author (ESA)

N81-17755# Department of Housing and Urban Development, Washington, D. C. Office of ACP Systems Development.
COBOL REALIGNMENT SYSTEM DOCUMENTATION
Dale A. Brenneman Jul. 1980 38 p
(PB81-100414; HUD/DF-80-001A) Avail: NTIS HC A03/MF A01 CSCL 09B

A system which realigns a COBOL program into a more readable and standard form for maintenance and debugging purposes is described. The input to the system is a COBOL source program which has been compiled with no errors. The output is a new source program which has been realigned along the following lines: (a) realignment of the left margins of procedure division entries, such as indentation of if-else statements for readability of imbedded statements; (b) blank lines before paragraphs; (c) restructuring of record descriptions in the data division, including picture clauses beginning at 01 incremented by two and indented according to level number hierarchy; and (d) resequencing of columns 1 thru 6 in increments of 10. GRA

62 COMPUTER SYSTEMS

Includes computer networks.

No abstracts in this category.

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N81-17756# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
RESEARCH IN KNOWLEDGE REPRESENTATION FOR NATURAL LANGUAGE UNDERSTANDING Annual Report, 1 Sep. 1979 - 31 Aug. 1980
William A. Woods, Ronald J. Brachman, Robert J. Bobrow, P. Cohen, B. Goodman, D. Israel, J. Schmolze, and C. Sidner Nov. 1980 40 p refs
(Contract N00014-77-C-0378; ARPA Order 3414)
(AD-A092971; BBN-4513) Avail: NTIS HC A03/MF A01 CSCL 09/2

BBN's ARPA project in Knowledge Representation for Natural Language Understanding is aimed at developing techniques for computer assistance to a decision maker in understanding a complex system or situation using natural language control of an intelligence graphics display. The work that we have been doing falls into three classes: fluent natural language understanding in a graphics context including helpful systems that go beyond mere passive execution of literal instructions, fundamental problems of knowledge representation and use, and abstract parallel algorithms for knowledge base inferential operations. In this report, we will give a brief summary of the activities of this research project during the past year, in particular in the areas of research on parallel algorithms and VLSI, research on the KL-ONE system, and research on natural language understanding. In addition, we document publications written, presentations given and workshops attended. GRA

N81-17757# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
BRAND X MANUAL

Peter Szolovits and William A. Martin Nov. 1980 24 p refs (Contract N00014-75-C-0661; Grant PHS-1-P01-LM-03374-02)
(AD-A093041; MIT/LCS/TM-186) Avail: NTIS HC A02/MF A01 CSCL 09/2

Brand X is a simple representation language implemented as a pure extension of LISP. Brand X provides the following additional facilities over LISP: unique and canonical structures, property lists for all objects, labels for all objects, and a syntax to express each of these, supported by a reader and printer. Brand X is intended as an 'assembly language' for representation languages, attempting to provide facilities generally found useful in the simplest manner, without any strong commitment to specific representational conventions. GRA

N81-17758# Yale Univ., New Haven, Conn. Dept. of Computer Science.
GENERALIZATION AND MEMORY IN AN INTEGRATED UNDERSTANDING SYSTEM
Michael Lebowitz Oct. 1980 319 p refs
(Contract N00014-75-C-1111)
(AD-A093083; RR-186) Avail: NTIS HC A14/MF A01 CSCL 09/2

Generalization and memory are part of natural language understanding. As people read stories describing various situations they are able to recall similar episodes from memory and use them as a basis to form generalizations about the way such situations normally occur. This thesis describes an integrated system for language understanding IPP (Integrated Partial Parser), that encompasses the ability to generalize and record information in long-term memory as well as conceptual analysis. IPP is a program that learns about the world by reading stories taken from newspapers and the UPI news wire, adding information from these stories to memory, and making generalizations that describe specific situations. It uses the generalizations that it has made to help in understanding future stories. As it reads stories, IPP adds them to its permanent memory. If it locates similar stories in memory as it does this, then it attempts to make generalizations that describe the similarities among the events. Such generalizations form the basis for organizing events in memory and understanding later stories. IPP also includes a procedure for confirming generalizations as further stories are read. In order to analyze the text that it reads, IPP makes extensive use of top-down, predictive processing. As it processes a story, IPP accesses memory in an attempt to identify generalizations describing stereotypical situations that can provide predictions to be used in understanding. Such use of memory to provide top-down context results in a robust and efficient understanding system. GRA

N81-17759# Brown Univ., Providence, R. I. Dept. of Engineering.
PRACTICAL METHODS FOR THE COMPENSATION AND CONTROL OF MULTIVARIABLE SYSTEMS Interim Report
William A. Wolovich and Peter L. Falb 31 Oct. 1980 19 p refs
(Grant AF-AFOSR-3182-77; AF Proj. 2304)
(AD-A093126; AFOSR-80-1226TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A new parameter adaptive control scheme for linear multivariable systems has been developed. It is felt that such an adaptive controller could be used in a variety of aerospace applications. A 'multi-purpose' controller has been designed which simultaneously decouples, places poles arbitrarily, rejects disturbances, insures zero error tracking, and is robust with respect to parameter variations. A new and straightforward method for obtaining simple low order models of systems whose dynamical behavior approximates that of more complex, higher order systems has also been developed. Such low order models can be used in the design of low compensators for the more complex systems. A complete new resolution has been presented to the question of what changes occur to the individual transfer matrix of elements of a linear multivariable system under local, scalar output feedback. In particular, it has been shown what poles become controllable and observable via any input/output pair when constant gain output feedback is applied between any (i-th) output and any (j-th) input. The question of parameter variation and the development of compensators which are insensitive to that variation has been resolved for a specific feedback group and is being studied for systems with parameters. Results have also been obtained for the pole-assignment problem involving parameters using intersection theory and some preliminary work has been done on the realization, coprime factorization and trace assignment problems for systems defined over the polynominal ring in n-variable over the integers. GRA

N81-17760# University of Southern California, Los Angeles. Image Processing Inst.
IMAGE UNDERSTANDING RESEARCH Semiannual Technical Report, 1 Apr. - 30 Sep. 1980
Ramakant Nevatia and Alexander A. Sawchuk 30 Sep. 1980 214 p refs
(Contract F33615-80-C-1080; DARPA Order 3119)
(AD-A094006; USCIPI-990) Avail: NTIS HC A10/MF A01 CSCL 05/8

The purpose of this research program is to develop techniques and systems for understanding images, particularly for mapping applications. The research activity includes low level image analysis and feature extraction, statistical and structural texture analysis, symbolic image representations, and image to map correspondence using relational structures. Additional activity is concerned with VLSI architectures for implementation of image analysis and image understanding operations. GRA

N81-17761# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
INTERFACING THE ONE-DIMENSIONAL SCANNING OF AN IMAGE WITH THE APPLICATIONS OF TWO-DIMENSIONAL OPERATORS
Shimon Ullman Apr. 1980 14 p refs
(Contract N00014-75-C-0643; Grant NSF MCS-77-07569)
(AD-A093932; AI-M-591) Avail: NTIS HC A02/MF A01 CSCL 05/8

To interface between the one dimensional scanning of an image, and the application of a two dimensional operator, an intermediate storage is required. For a square image of size n to the 2nd power and a square operator of size m to the 2nd power the minimum intermediate storage is shown to be n (m-1). An interface of this size can be conveniently realized by using a serpentine delay line. New kinds of imagers would be required to reduce the size of the intermediate storage below n x (m-1). GRA

N81-17762# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
A SIMULATION ANALYSIS OF SOJOURN TIMES IN A JACKSON NETWORK
Peter C. Kiessler Dec. 1980 124 p refs
(Contract N00014-77-C-0743; Grant NSF ENG-77-22757; NR Proj. 042-296)
(AD-A093707; VTR-80-16) Avail: NTIS HC A02/MF A01 CSCL 12/1

This thesis analyzes the total sojourn time distribution of a three queue acyclic Jackson network with the following characteristics. The network consists of three single server queues, Q1, Q2, and Q3, each having exponential service times. There is a Poisson exogenous arrival process to Q1. Customers departing Q1 go immediately to Q2, w.p. p, or to Q3, w.p. 1-p. Customers departing Q2 go immediately to Q3 and those departing Q3 leave the network. For different parameter settings, the network is simulated and the sojourn times at each of the queues are recorded. Due to the structure of the network, a simple simulation which correctly models the network can be constructed. It is known from Simon and Foley (1979), that the sojourn times of a customer in Q1 and Q3 are dependent. It is shown, that, except for extremely large sample sizes, 5000, that the correlation between the sojourn times in Q1 and Q3 is not significant. However, in the case of 5000 observations, this correlation is shown to be significantly greater than zero for certain parameter settings. Finally, the sample total sojourn time distribution is compared to one assuming independence of the sojourn times at each of the queues. It is shown that the sample distribution and the total sojourn time distribution assuming independence are not significantly different, except for p = 0. GRA

N81-17763# Maryland Univ. -College Park. Computer Vision Lab.

SOME PROPERTIES OF DIGITAL CURVES AND SURFACES

Azriel Rosenfeld and David G. Morgenthaler Sep. 1980 23 p refs

(Grant AF-AFOSR-3271-77)

(AD-A092934; TR-942) Avail: NTIS HC A02/MF A01 CSCL 09/2

Several characterizations of simple closed curves in two dimensional arrays (digital pictures) are shown to be inadequate to characterize simple closed surfaces in three dimensional arrays; but the 2d analog of a recently given 3d definition of 'surface' does characterize curves. GRA

N81-17764# Bonn Univ. (West Germany). Inst. fuer Kommunikationsforschung und Phonetik.

AUTOMATIC SPEECH RECOGNITION: THE DAWID SYSTEM [AUTOMATISCHE SPRACHERKENNUNG: DAS DAWID-SYSTEM]

H. Bierfert, R. D. Glave, M. Kirstein, D. Lance, C. Reinhard, and G. vanderGiet Bundesministerium fuer 'Verteididung 1979 225 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Verteididung

(BMVg-FBWT-79-22) Avail: NTIS HC A10/MF A01; DOKZENTBW, Bonn DM 50

A collection of papers describing progress in the development of the DAWID speech recognition system as well as the different approaches in evaluating and measuring the performance of the system, especially with respect to applications, is presented. DAWID is a real time isolated word recognition machine consisting of a hardware analyzer and a software classifier programmed on a PDP computer. The analyzer is a compound of parallel channels operating primarily in the time domain and decomposing each acoustic signal into seven binary parameter signals. This permits phonetic segmentation and labelling as the first step in classification. Further processes involve heuristic similarity algorithms which work on these quasiphonetic strings. The efficiency of the system was improved by incorporating a finite state syntax processor. The branching factor is about 250. Author (ESA)

N81-17765# Sheffield Univ. (England). Dept. of Control Engineering.

PARAMETER UNCERTAINTY AND TIME-DELAY SYSTEM CONTROL

A. Chotai Aug. 1980 24 p refs Presented at the 3d IMA Conf. on Control Theory, Sheffield, England, Sep. 1980

(RR-116) Avail: NTIS HC A02/MF A01

A general scheme for time-delay control systems is presented which shows that with particular choice of system elements and loop gain, many of the existing time-delay systems can be recovered. The effects of plant/model mismatch on optimal control and sensitivity expressions are discussed. A relationship between time delay controllers with mismatch and a delay-free system with delay added in a controller is established. Various L.Q.P. cases are discussed and the suboptimality of published schemes induced by mismatch is exposed. Author (ESA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N81-17766*# Michigan Univ., Ann Arbor.

CLOSED-FORM SOLUTIONS OF PERFORMABILITY

J. F. Meyer Jan. 1981 44 p refs

(Grant NsG-1306)

(NASA-CR-163933; SEL-147; Rept-014524-16-T) Avail: NTIS HC A03/MF A01 CSCL 12A

Methods which yield closed form performability solutions for continuous valued variables are developed. The models are similar to those employed in performance modeling (i.e., Markovian queueing models) but are extended so as to account for variations in structure due to faults. In particular, the modeling of a degradable buffer/multiprocessor system is considered whose performance Y is the (normalized) average throughput rate realized during a bounded interval of time. To avoid known difficulties associated with exact transient solutions, an approximate decomposition of the model is employed permitting certain submodels to be solved in equilibrium. These solutions are then incorporated in a model with fewer transient states and by solving the latter, a closed form solution of the system's performability is obtained. In conclusion, some applications of this solution are discussed and illustrated, including an example of design optimization. M.G.

N81-17767# National Aerospace Lab., Tokyo (Japan). Computer Center.

ON THE NONLINEAR GROUP ASSOCIATED WITH A NONLINEAR DISPERSIVE EQUATION

Tadayasu Takahashi and Toshiyuki Iwamiya Sep. 1980 16 p refs

(NAL-TR-626T) Avail: NTIS HC A02/MF A01

An initial periodic boundary value problem for a nonlinear dispersive equation, which is a modified version of the Kortweg-de Vries equation, is studied from the point of view of the theory of semigroups of nonlinear operators. The initial boundary value problem is reduced to the abstract Cauchy problem for a nonlinear evolution equation in a function space, and it is shown that the evolution equation admits regular solutions which form a nonlinear semigroup consisting of differentiable operators on the function space. Furthermore, it is shown that the semigroup is embedded in a nonlinear group of C(1) diffeomorphisms on the function space and the group possesses various interesting properties. Author

N81-17768# Texas Univ. at Austin. Center for Cybernetic Studies.

A NON-ORTHOGONAL FOURIER EXPANSION FOR CONIC DECOMPOSITION

J. Barzilai and A. Ben-Tal (Israel Inst. of Technology, Haifa) Sep. 1980 31 p refs Revised

(Contract N00014-75-C-0569)

(AD-A092948; CCS-RR-380-Rev) Avail: NTIS HC A03/MF A01 CSCL 12/1

The problem considered is that of constructing the decomposition of a vector in a Hilbert space into two orthogonal components; one (the 'projection') in a given cone, and the other in the polar cone. The projection Z^* can be expressed as a Fourier-type expansion. An algorithm for constructing this expansion is given, and shown to converge to Z^*. GRA

N81-17769# Texas Univ. at Austin. Center for Cybernetic Studies.

THE M-TRAVELING SALESMEN PROBLEM Ph.D. Thesis

I. Ali and J. Kennington (Southern Methodist Univ., Dallas, Tex.) Jul. 1980 22 p refs

(Contract N00014-75-C-0569; Grant AF-AFOSR-3151-77)

(AD-A092949; CCS-RR-381) Avail: NTIS HC A02/MF A01 CSCL 12/2

This paper develops the number of feasible solutions (m-tours) for both the asymmetric and symmetric m-travelling salesmen problems. The proofs are constructive and it is shown how these results may be used to design an enumeration tree for incorporation within a general branch-and-bound algorithm. In addition, for the m-travelling salesmen problem defined over the Euclidean vector space in which the number of salesmen used is a decision variable, it is shown that there exists an optimal tour using only one salesman. GRA

N81-17770# Texas Univ. at Austin. Center for Cybernetic Studies.

THE M-TRAVELING SALESMEN PROBLEM: A DUALITY BASED BRANCH-AND-BOUND ALGORITHM Ph.D. Thesis

I. Ali and J. Kennington (Southern Methodist Univ., Dallas, Tex.) Aug. 1980 40 p refs

(Contract N00014-75-C-0569; Grant AF-AFOSR-3151-77)

(AD-A092951; CCS-RR-382) Avail: NTIS HC A03/MF A01 CSCL 12/2

This paper presents a new model and branch-and-bound algorithm for the m-travelling salesmen problem. The algorithm uses a Lagrangian relaxation, a subgradient algorithm to solve the Lagrangian dual, a greedy algorithm for obtaining minimal

m-trees, penalties to strengthen the lower bounds on candidate problems, and a new concept known as staged optimization. Computational experience for both symmetric and asymmetric problems having up to 100 cities is presented. GRA

N81-17771# Indiana Univ. at Bloomington. Dept. of Mathematics.

SHORTED MATRICES: AN EXTENDED CONCEPT AND SOME APPLICATIONS IN DESIGN AND ANALYSIS OF EXPERIMENTS Interim Report

Sujit kumar Mitra and Madan L. Puri 1980 31 p refs
(Grants AF-AFOSR-2927-76; NSF MCS-76-00951; AF Proj. 2304)
(AD-A093187; AFOSR-76-2927TR; AFOSR-80-1294TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The concept of a shorted operator on the cone C sub n of nonnegative definite matrices of order n x n introduced by Krein and studied recently by Anderson and Trapp is extended to a wider class of matrices. For matrices in C sub n, the shorting operation is permissible with reference to any subspace S of the n dimensional Euclidean space E to the nth power, provided restrictions are symmetrically placed on the row and column spans. For general matrices, the shorting operation is uniquely defined if and only if certain conditions are satisfied by the matrix itself and by subspaces providing restrictions on the row and column spans. The key point in this development is a theorem of Anderson and Trapp which exhibits the shorted n.n.d. matrix as the limit of a sequence of parallel sum operators. Some applications of the shorted operator in mathematical statistics with special reference to the design and analysis of experiments are provided. GRA

N81-17772# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

AN OUTLOOK ON TRUTH MAINTENANCE

David A. McAllester Aug. 1980 49 p refs
(Contract N00014-75-C-0643; Grant NSF MCS-77-04828)
(AD-A093190; AI-M-551) Avail: NTIS HC A03/MF A01 CSCL 12/1

Truth maintenance systems (TMS) have been used in several recent problem-solving systems to record justifications for deduced assertions, to track down the assumptions which underlie contradictions when they arise, and to incrementally modify assertional data structures when assumptions are retracted. This report describes a TMS algorithm that is substantially different from previous systems. This algorithm performs deduction in traditional propositional logic in such a way that the premise set from which deduction is being done can be easily manipulated. A novel approach is also taken to the role of a TMS in larger deductive systems. In this approach the TMS performs all propositional deduction in a uniform manner while the larger system is responsible for controlling the instantiation of universally quantified formulae and axiom schemas. GRA

N81-17773# Massachusetts Univ., Amherst. Dept. of Mathematics and Statistics.

OPTIMALITY MEASURES FOR MONOTONE EQUIVARIANT CLUSTER TECHNIQUES

M. F. Janowitz Sep. 1980 35 p refs Presented at the Classification Soc. Meeting, 9 Apr. 1979
(Contract N00014-79-C-0629)
(AD-A093313; TR-J8001) Avail: NTIS HC A03/MF A01 CSCL 12/1

Several commonly used optimality measures are compared and classified as to their performance with monotone equivariant cluster techniques. A new measure is introduced and compared to the earlier measures. The measures are then applied to determining the optimality of several cluster techniques when they are applied to some concrete data that arises from the psychological and social sciences. GRA

N81-17774# Texas Univ. at Austin. Dept. of Electrical Engineering.

[NONLINEAR REGRESSION ANALYSIS] Final Scientific Report

Gary L. Wise 26 Nov. 1980 42 p refs
(Grant AF-AFOSR-3062-76; AF Proj. 2304)
(AD-A093218; AFOSR-80-1300TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This is the Final Scientific Report of the Grant AFOSR-76-3062. In it is given a brief survey of results achieved in the areas of nonlinearities with random inputs, regression functions, detection in Laplace noise, relative efficiency of detectors, signal detection independent noise, estimation of probability density functions from noisy measurements, polynomial expansions, median filtering, spherically invariant random processes, support estimation, and quantization theory. GRA

N81-17775# Mississippi State Univ., Mississippi State. Engineering Industrial Research Station.

NUMERICAL GENERATION OF TWO-DIMENSIONAL ORTHOGONAL CURVILINEAR COORDINATES IN AN EUCLIDEAN SPACE Interim Report

Z. U. A. Warsi, R. A. Weed, and J. F. Thompson Jun. 1980 41 p refs
(Grant AF-AFOSR-0185-80; AF Proj. 2304)
(AD-A093299; MSSU-EIRS-ASE-80-3; AASE-80-213; AFOSR-80-1339TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper a non-iterative method for the numerical generation of orthogonal curvilinear coordinates for plane annular regions between two arbitrary smooth closed curves has been developed. The basic generating equation is the Gaussian equation for an Euclidean space which has been solved analytically. The method has been applied in many cases and these test results demonstrate that the proposed method can be readily applied to a wide variety of problems. GRA

N81-17776# Indiana Univ. at Bloomington. Dept. of Mathematics.

ADMISSIBILITY OF ESTIMATORS IN THE ONE PARAMETER EXPONENTIAL FAMILY AND IN MULTIVARIATE LOCATION PROBLEMS Ph.D. Thesis. Interim Report

Dan A. Ralescu Sep. 1980 80 p refs
(Grant AF-AFOSR-2927-76; AF Proj. 2304)
(AD-A093188; AFOSR-80-1295TR) Avail: NTIS HC A05/MF A01 CSCL 12/1

We are concerned with problems related to admissibility and minimaxity of estimators in the one parameter exponential family, and with classes of estimators which improve upon the best invariant estimator in multivariate location problems (dimensions p = or -3). In connection with admissibility problems we give sufficient conditions for the admissibility of nonlinear estimators (aX - b)/(Cx - d) in estimating an arbitrary function g(theta) with quadratic loss. GRA

N81-17777# Brown Univ., Providence, R. I. Center for Dynamical Systems.

BIFURCATION AND NONLINEAR OSCILLATIONS Interim Report

Shui-Nee Chow (Michigan State Univ., East Lansing) 28 Sep. 1980 50 p refs
(Contract DAAG29-79-C-0161; Grants NSF MCS-79-05774; NSF MCS-76-06739; AF-AFOSR-3092-76)
(AD-A093182; AFOSR-80-1179TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Two problems are discussed. The first one deals with the characterization of the flow for a periodic planar system which is the perturbation of an autonomous system which possesses either a saddle-node or degenerate focus or degenerate periodic orbit or homoclinic orbit. The second problem concerns the characterization of the flow near an equilibrium point of an autonomous equation when the linear variational equation has either two purely imaginary and one zero eigenvalue or two pairs of purely imaginary eigenvalues. GRA

N81-17778# California Univ., Berkeley. Operations Research Center.

SUBSTITUTES AND COMPLEMENTS IN NETWORK FLOW PROBLEMS

David Gale and Themistocles Politof Oct. 1980 28 p refs
(Contract N00014-76-C-0134; Grant NSF SES-78-05198)
(AD-A093786; ORC-80-23) Avail: NTIS HC A03/MF A01 CSCL 12/1

If f is a function of several variables, one calls a pair of variables substitutes (complements) if the change of the value

of the function when both variables are increased is at most (at least) equal to the sum of the changes when each is increased separately. We here consider the case where f is the value of a maximum weight circulation on a network and the variables are the upper and lower bounds and the weights of a pair of arcs. We introduce a simple combinatorial criterion for two arcs to be in 'series' or 'parallel' and show that these two cases correspond to the variables being complements or substitutes respectively. This generalizes results of Shapley for the special case of the maximum flow and optimal assignment problems. We also show that our result is the best possible in that if two arcs are neither in series nor parallel, then the corresponding variables can be either substitutes or complements or both. GRA

N81-17779# Wisconsin Univ. - Madison. Mathematics Research Center.

ELEMENTARY PROOFS OF AN INEQUALITY FOR SYMMETRIC FUNCTIONS FOR n > OR EQUAL TO 5 Summary Report

Roland Zielke Aug. 1980 18 p refs
(Contract DAAG29-80-C-0041)
(AD-A093574; MRC-TSR-2113) Avail: NTIS
HC A02/MF A01 CSCL 12/1

Some aspects of the heat transfer in the emergency cooling of nuclear reactors lead to a nonlinear eigenvalue problem, the so-called model quelch front problem. Laquer and Wendroff suggested a procedure for computing bounds of the eigenvalue which depend - among other things - on the validity of a certain inequality for elementary symmetric functions. This inequality is of interest in itself and was recently proved by Efroymson, Swartz and Wendroff using a fairly complicated argument. We give an elementary proof for n less than or equal to 5. Author (GRA)

N81-17780# Wisconsin Univ. - Madison. Mathematics Research Center.

NUMERICAL CONSTRUCTION OF SMOOTH SURFACES FROM AGGREGATED DATA Technical Summary Report

Nira Dyn and Warren Ferguson Oct. 1980 24 p refs
(Contract DAAG29-80-C-0041)
(AD-A093575; MRC-TSR-2129) Avail: NTIS
HC A02/MF A01 CSCL 12/1

The numerical construction of a smooth surface with prescribed weighted integrals over a domain of interest, is investigated. This construction is mostly relevant to the estimation of a smooth density function over geographical regions, from data aggregated over several subregions. By analogy to the definition of the univariate histospline the smooth surface is defined as the solution to a certain constrained minimization problem. The application of finite element methods to the numerical solution of the minimization problem is studied. It is shown that any finite element procedure, convergent for a related boundary value problem can be used to construct a sequence of finite element approximations converging to the smooth surface which solves the constrained minimization problem. For the case of smoothness requirement of lowest order, a specific finite element method is considered, and its convergence as the mesh size decreases is demonstrated numerically for a particular example of volume matching. GRA

N81-17781# Wisconsin Univ. - Madison. Mathematics Research Center.

CONTINUITY FOR WEAK SOLUTIONS TO CERTAIN SINGULAR PARABOLIC EQUATIONS Technical Summary Report

Emmanuele DiBenedetto Oct. 1980 87 p refs
(Contract DAAG29-80-C-0041; Grant NSF MCS-78-09525)
(AD-A093607; MRC-TSR-2124) Avail: NTIS
HC A05/MF A01 CSCL 12/1

It is demonstrated that weak solutions of (parabolic equations) in the introduction are continuous in their domain of definition. The continuity up to the boundary is also investigated. GRA

N81-17782# Wisconsin Univ. - Madison. Mathematics Research Center.

AN UPDATED VERSION OF THE KANTOROVICH THEOREM FOR NEWTON'S METHOD Technical Summary Report

George J. Miel Oct. 1980 17 p refs
(Contract DAAG29-80-C-0041)
(AD-A093608; MRC-TSR-2125) Avail: NTIS
HC A02/MF A01 CSCL 12/1

An affine invariant version of the Kantorovich theorem for Newton's method is presented. The result includes the Gragg-Tapia error bounds, as well as recent optimal and sharper upper bounds, new optimal and sharper lower bounds, and new inequalities showing q-quadratic convergence all in terms of the usual majorizing sequence. Closed form expressions for these bounds are given. GRA

N81-17783# Wisconsin Univ. - Madison. Mathematics Research Center.

SOME APPROXIMATION PROPERTIES IN ORLICZ-SOBOLEV SPACES Technical Summary Report

Jean-Pierre Gossez Oct. 1980 18 p refs
(Contract DAAG29-80-C-0041)
(AD-A093609; MRC-TSR-2126) Avail: NTIS
HC A02/MF A01 CSCL 12/1

We prove that weak derivatives in general Orlicz spaces are globally strong derivatives with respect to the modular convergence. Other approximation theorems involving the modular convergence are presented, which improve known density results of interest in the existence theory for strongly nonlinear boundary value problems. GRA

N81-17784# Wisconsin Univ. - Madison. Mathematics Research Center.

ON PERIODIC WATER-WAVES AND THEIR CONVERGENCE TO SOLITARY WAVES IN THE LONG-WAVE LIMIT

C. J. Amick and J. F. Toland Oct. 1980 77 p refs
(Contract DAAG29-80-C-0041)
(AD-A093610; MRC-TSR-2127) Avail: NTIS
HC A05/MF A01 CSCL 12/1

A detailed discussion of Nekrasov's approach to the steady water-wave problems leads to a new integral equation formulation of the periodic problem. This development allows the adaptation of the methods of (1) to show the global convergence of periodic waves to solitary waves in the long-wave limit. In addition, it is shown how the classical integral equation formulation due to Nekrasove leads, via the Maximum Principle, to new results about qualitative features of periodic waves, for which there has long been a global existence theory (9, 12). GRA

N81-17785# Wisconsin Univ. - Madison. Mathematics Research Center.

APPLICATION OF INTERVAL INTEGRATION TO THE SOLUTION OF INTEGRAL EQUATIONS

L. B. Rall Oct. 1980 21 p refs
(Contract DAAG29-80-C-0041)
(AD-A093611; MRC-TSR-2128) Avail: NTIS
HC A02/MF A01 CSCL 12/1

A method of numerical solution is presented for a class of integral equations which includes linear and nonlinear equations encountered in applications. A brief sketch is given of methods from classical analysis (inversion of power series) and functional analysis (functional and monotone iteration), together with some of their shortcomings (difficulty of implementation, error estimation, and special conditions on operators and initial approximations). Interval functions, which may be considered to be sets consisting of all functions bounded above and below by given end-point functions, are defined, and the recently developed theory of interval integration is used to construct interval extensions of real integral operators. These interval operators are used to define an interval iteration process which converges if the initial interval contains a solution of the integral equation. Furthermore, the endpoint functions of the interated interval functions provide upper and lower bounds for the solution at each stage of the iteration, and the interval iteration operator can be constructed so that the results of each transformation can be represented exactly. A numerical example is given of an interval iteration which gives a numerical solution of a nonlinear integral equation outside the limits of convergence of classical and function methods. Some problems connected with the use of interval iteration are also discussed. GRA

N81-17786# Pittsburgh Univ., Pa. Dept. of Mathematics and Statistics.

SOME COMMENTS ON THE MINIMUM MEAN SQUARE

ERROR AS A CRITERION OF ESTIMATION Interim Report
C. Radhakrishna Rao Oct. 1980 41 p refs
(Contract F49620-79-C-0161; AF Proj. 2304)
(AD-A093824; TR-80-21; AFOSR-80-1343TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

It is shown that estimators obtained by MMSE (minimizing the mean square error) may not have optimum properties with respect to other criteria such as PN (probability of nearness to the true value in the sense of Pitman) or PC (probability of concentration around the true value). In particular, a detailed study is made of estimators obtained by shrinking the minimum variance unbiased estimators to reduce the MSE. It is suggested that because of mathematical convenience and some intuitive considerations, MMSE could be used as a primitive postulate to derive estimators, but their acceptability should be judged on more intrinsic criteria such as PN and PC. GRA

N81-17787# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
NUMERICAL METHODS FOR 2-DIMENSIONAL MODELING Semiannual Technical Report, 1 Jul. - 31 Dec. 1980
W. D. Murphy and W. F. Hall Dec. 1980 41 p refs
(Contract MDA903-80-C-0498; DARPA Order 3984)
(AD-A093843; SC5271.3SA; SATR-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

Progress toward the development of a fast algorithm for two dimensional computational modeling of VLSI fabrication processes is described. The first report of an algorithm producing two dimensional dopant profiles in seconds per process step is presented. A summary of investigations to date and plans for future work are discussed. GRA

N81-17788# Wisconsin Univ. - Madison. Mathematics Research Center.
ON THE INITIAL VALUE PROBLEM FOR A NONLINEAR SCHROEDINGER EQUATION Summary Report
Guang-Chang Dong and Shujie Li Oct. 1980 20 p refs
(Contract DAAG29-80-C-0041)
(AD-A093614; MRC-TSR-2133) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper we study conditions that ensure existence and uniqueness of solution to the initial value problem for the nonlinear Schrodinger equation. Many known results in the one dimensional space are extended to the higher dimensional cases. We also establish bounds and investigate decay properties for the solution. GRA

N81-17789# Wisconsin Univ. - Madison. Mathematical Research Center.
ASYMPTOTIC BEHAVIOR OF SOME NONLINEAR HEAT EQUATIONS Summary Report
P. L. Lions Nov. 1980 27 p refs
(Contract DAAG29-80-C-0041)
(AD-A093615; MRC-TSR-2134) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper a semilinear heat equation with a convex nonlinearity is considered. The asymptotic behavior of the solutions is completely determined and this gives, in particular, a very precise description of the global stability of stationary solutions. GRA

N81-17790# Wisconsin Univ. - Madison. Mathematics Research Center.
THE CONNECTION BETWEEN PARTIAL DIFFERENTIAL EQUATIONS SOLUBLE BY INVERSE SCATTERING AND ORDINARY DIFFERENTIAL EQUATIONS OF PAINLEVE TYPE
J. B. McLeod and P. J. Olver Nov. 1980 42 p refs
(Contract DAAG29-80-C-0041)
(AD-A093616; MRC-TSR-2135) Avail: NTIS HC A03/MF A01 CSCL 12/1

A completely integrable partial differential equation is one which has a Lax representation, or, more precisely, can be solved via a linear integral equation of Gel'fand-Levitan type, the classic example being the Korteweg-de Vries equation. An ordinary differential equation is of Painleve type if the only singularities of its solutions in the complex plane are poles. It is shown that, under certain restrictions, if G is an analytic, regular symmetry group of a completely integrable partial differential equation, then the reduced ordinary differential equation for the G-invariant solutions is necessarily of Painleve type. This gives a useful necessary condition for complete integrability, which is applied to investigate the integrability of certain generalizations of the Korteweg-de Vries equation, Klein-Gordon equations, some model nonlinear wave equations of Whitham and Benjamin, and the BBM equation. GRA

N81-17791# Wisconsin Univ. - Madison. Mathematics Research Center.
CLINES INDUCED BY VARIABLE SELECTION AND MIGRATION Summary Report
P. C. Fife and L. A. Peletier Sep. 1980 52 p refs
(Contract DAAG29-80-C-0041; Grants NSF MCS-78-04443; NSF MCS-78-02158)
(AD-A093629; MRC-TSR-2115) Avail: NTIS HC A04/MF A01 CSCL 12/1

The problem studied is in the area of differential equations; it models the spatial distribution of the genetic composition of a population in a heterogeneous environment, account being taken of migration and natural selection effects. More generally, it models a distribution in the composition of an ecological community. A number of conditions are given which guarantee the existence or nonexistence of a stable nonuniform equilibrium distribution, which is known as a cline. Of special interest is the case when two stable homogeneous distributions are possible; there may or may not also exist a heterogeneous one. GRA

N81-17792# Wisconsin Univ. - Madison. Mathematics Research Center.
SOLUTION OF PACKED-BED HEAT-EXCHANGER MODELS BY ORTHOGONAL COLLOCATION USING PIECEWISE CUBIC HERMITE FUNCTIONS Summary Report
Anthony G. Dixon Sep. 1980 44 p refs
(Contract DAAG29-80-C-0041; Grant NSF ENG-76-24368)
(AD-A093630; MRC-TSR-2116) Avail: NTIS HC A03/MF A01 CSCL 12/1

Orthogonal collocation using piecewise cubic Hermite functions is used to solve the elliptic partial differential equations arising from pseudo-continuum models of heat transfer in a packed bed. Problems arising from a discontinuity in the wall boundary condition and from the semi-infinite domain of the differential operator are discussed. Comparison is made between the computed solution and experimental results. GRA

N81-17793# Wisconsin Univ. - Madison. Mathematics Research Center.
THE BEHAVIOR OF SPHERICALLY SYMMETRIC EQUILIBRIA NEAR INFINITY Summary Report
C. Conley Sep. 1980 13 p
(Contract DAAG29-80-C-0041)
(AD-A093631; MRC-TSR-2117) Avail: NTIS HC A02/MF A01 CSCL 12/1

The study of the radially symmetric equilibria of a non-linear diffusion equation in several space dimensions leads to an ordinary differential equation. Under the hypotheses that the reaction terms are in gradient form, conditions are found which imply that solutions are asymptotically constant at infinity. As an application it is shown that the all spherically symmetric solutions of the sine-Gordon equation are asymptotically constant (and consequently bounded). GRA

N81-17794# Wisconsin Univ. - Madison. Mathematics Research Center.
SOLUTIONS OF ASYMPTOTICALLY LINEAR OPERATOR EQUATIONS VIA MORSE THEORY
Kung-Ching Chang (Peking Univ.) Sep. 1980 26 p refs
(Contract DAAG29-80-C-0041)
(AD-A093635; MRC-TSR-2121) Avail: NTIS HC A03/MF A01 CSCL 21/1

In this paper, we use the classical Morse theory of critical points to study the existence and multiplicity of solutions of a class of asymptotically linear operator equations. As special cases, we include multiplicity results for semilinear elliptic BVP's, as well as existence and multiplicity of periodic solutions of semilinear wave equation and of Hamiltonian systems. These results simplify

and complement recent work of Amann Zehnder and Castro Lazer. GRA

N81-17795# Wisconsin Univ. - Madison. Mathematics Research Center.

A THEOREM CONCERNING UNIFORM SIMPLIFICATION AT A TRANSITION POINT AND THE PROBLEM OF RESONANCE

Yasuteka Sibuya Aug. 1980 30 p refs
(Contract DAAG29-80-C-0041; Grant NSF MCS-79-01998)
(AD-A093564; MRC-TSR-2103) Avail: NTIS HC A03/MF A01 CSCL 12/1

In a certain situation which arises naturally in applications Lim V as epsilon approaches 0 (x, epsilon) = 0 identically for practically all the solutions v of (1), except when F and G are related in a specific way. This exceptional case is called the case of resonance. It is important to find an effectively computable condition for the resonance. B. J. Matkowsky found such a condition. However, so far, it has been mathematically very difficult to prove that the Matkowsky-condition actually guarantees the resonance. The difficulty is due to the fact that a quantity which is decisive in determining the resonance is so small that any existing mathematical tool has failed to dig this quantity out of the differential equation clearly. In this work, we shall provide such a tool. GRA

N81-17796# Wisconsin Univ. - Madison. Mathematics Research Center.

EVALUATION OF COMPLEX LOGARITHMS AND RELATED FUNCTIONS

George J. Miel (Nevada Univ., Las Vegas) Aug. 1980 18 p refs
(Contract DAAG29-80-C-0041)
(AD-A093565; MRC-TSR-2104) Avail: NTIS HC A02/MF A01 CSCL 12/1

An algorithm is presented for computing ln z with complex arithmetic, by extending to the complex plane Carlson's treatment of a classical iteration using arithmetic and geometric means. Although not competitive with current techniques which handle the real and imaginary parts separately, the algorithm may be useful in special purpose applications. A detailed analysis of convergence, scaling, and roundoff is given. Standard identities and some minor bookkeeping allow the evaluation of inverse circular and inverse hyperbolic functions. It is also shown that the basic procedure is related to certain real algorithms. GRA

N81-17797# Wisconsin Univ. - Madison. Mathematics Research Center.

EXTREMAL POLYNOMIALS WITH APPLICATION TO RICHARDSON ITERATION FOR INDEFINITE LINEAR SYSTEMS Summary Report

Carl deBoor and John R. Rice Aug. 1980 30 p refs
(Contract DAAG29-80-C-0041; Grant NSF MCS-77-01408)
(AD-A093568; MRC-TSR-2107) Avail: NTIS HC A03/MF A01 CSCL 12/1

The application of Richardson iteration to a symmetric, but indefinite linear system requires certain parameters which can be determined from the zeros in the error of a certain best polynomial approximant on some set S known to contain the spectrum of the coefficient matrix. It is pointed out that this error can also be obtained as a multiple of the extremal polynomial for the linear functional p at p(0), and this leads to an efficient Remes type algorithm for its determination. A program incorporating this algorithm for the case that S consists of two intervals bracketing zero is also given. GRA

N81-17798# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Statistics.

THE DETERMINATION OF PROBABILITIES AND MOMENTS OF MEASURES OF VISIBILITY ON CURVES IN THE PLANE FOR POISSON

Micha Yadin and S. Zacks 15 Sep. 1980 11 p refs
(Contract N00014-80-C-0325)
(AD-A093414; VPI-TR-2) Avail: NTIS HC A02/MF A01 CSCL 12/1

A general methodology is developed for the determination of visibility probabilities, the distribution of the length of a line-of-sight and the moments of visibility measures on star-shaped curves on the plane, subject to shadowing by Poisson random objects. GRA

N81-17799# Washington Univ., St. Louis, Mo. Dept. of Systems Science and Mathematics.

THE CONSTRAINT METHOD FOR SOLID FINITE ELEMENTS Annual Report, 1 Oct. 1979 - 30 Sep. 1980

I. Norman Katz 30 Sep. 1980 10 p refs
(Grant AF-AFOSR-3122-77; AF Proj. 2304)
(AD-A093401; AFOSR-80-1338TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The p-version of the finite element method is briefly discussed. This approach to finite element analysis can lead to significant computational savings, often by orders of magnitude. Conventional approaches (called the H-version) generally employ low order polynomials as basis functions. Accuracy is achieved by suitably refining the approximating mesh. The p-version uses polynomials of arbitrary order p greater than or equal to 2 for problems in plane elasticity where C(0) continuity is required and polynomials of order p is greater than or equal to 5 for problems in plate bending where C(1) continuity is required. M.G.

N81-17800# Wisconsin Univ. - Madison. Dept. of Computer Sciences.

ON THE EIGENVALUES OF 2ND ORDER ELLIPTIC DIFFERENCE OPERATORS

Seymour V. Parter Nov. 1980 28 p refs
(Contract N00014-76-C-0341)
(AD-A093279; CSTR-405) Avail: NTIS HC A03/MF A01 CSCL 12/1

This work is motivated by the desire to extend the theory of iterative methods for the solution of the algebraic problems associated with L sub h, a finite difference operator. For this reason the operators N sub h will approximate N in a relatively 'weak' manner. In order to simplify the presentation we first consider a particular 'model' problem. Following that development we discuss the essential features of that discussion. Also described are the basic model problem and some well-known facts about this model problem. The convergence theorems are developed and ideas in our convergence proofs and their possible extension to more general problems are discussed. GRA

N81-17801# Cornell Univ., Ithaca, N. Y. Dept. of Computer Science.

A SUBEXPONENTIAL ALGORITHM FOR TRIVALENT GRAPH ISOMORPHISM

Merrick Furst (Carnegie-Mellon Univ.), John Hopcroft, and Eugene Luks (Bucknell Univ.) Jun. 1980 30 p refs Sponsored in part by NSF
(Contract N00014-76-C-0018)
(AD-A093321; CU-CSD-TR-80-426) Avail: NTIS HC A03/MF A01 CSCL 12/1

This report contains two results: First, a polynomial-time algorithm to test color preserving isomorphism of two vertex-colored graphs in which each color class is of size k or less; Second, we improve Hoffman's algorithm for determining the automorphism group of a trivalent cone graph to deterministic time O(n(clogn)) and extend it to arbitrary trivalent graphs. GRA

N81-17802# California Univ., Riverside. Dept. of Mathematics.

HARMONIZABLE PROCESSES: STRUCTURE

M. M. Rao 5 Nov. 1980 95 p refs
(Contract N00014-79-C-0754)
(AD-A093302; TR-1) Avail: NTIS HC A05/MF A01 CSCL 12/1

A unified and detailed treatment of the structure of harmonizable time series is considered. These are divided into strong (or Loeve) and weak (Bochner-Rozanov) classes and their characterizations as well as integral representations are obtained. Both concrete and operator versions of the characterizations of weakly harmonizable processes are given. The work here implies that weakly harmonizable class is the largest family of second order processes with continuous covariance for which Fourier analysis applies. The treatment includes random fields. It is shown that both the harmonizable processes have an associated spectrum, and they obey the weak law of large numbers. Multidimensional extensions and filtering are briefly discussed. Several open

problems and avenues of research growing out of this study are indicated at various places, so that the material presented here will form a firm basis for both the theory and applications to follow. GRA

N81-17803# Princeton Univ., N. J. Plasma Physics Lab.
THE MAXWELL-VLASOV EQUATIONS AS A CONTINUOUS HAMILTONIAN SYSTEM
P. J. Morrison Nov. 1980 13 p refs Submitted for publication Sponsored by DOE
(PPPL-1702R) Avail: NTIS HC A02/MF A01

The Maxwell-Vlasov equations that describe a collisionless plasma are cast into Hamiltonian form. The dynamical variables are the physical although noncanonical variables E, B and f. A Poisson bracket is presented which acts on these variables and the energy functional to produce the equations of motion. M.G.

N81-17804# Illinois Univ., Urbana. Dept. of Computer Science.
SELF ADAPTIVE METHODS FOR PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS Ph.D. Thesis
D. B. Gannon Aug. 1980 88 p refs
(Contract DE-AS02-76ER-02383)
(COO-2383-0074) Avail: NTIS HC A05/MF A01

Algorithms for the proper construction of locally refined grids for finite element-based methods for the solution to parabolic differential equations. Refinement criteria are developed and tested for parabolic problems. The computational complexity of such a strategy is studied, and algorithms based on nested dissection are presented to solve the associated linear algebra problems. DOE

N81-17805# Engins Matra, Velizy (France).
ANALOG CHARACTERISTICS OF SOME NUMERICAL FILTERS [CARACTERISTIQUES ANALOGIQUES DE QUELQUES FILTRES NUMERIQUES]
A. M. Perus, ed. 25 Apr. 1979 43 p In FRENCH; ENGLISH summary
(GA-325) Avail: NTIS HC A03/MF A01

The behavior of a numerical filter is defined through its analog characteristics. In particular, cut-off pulses and the slopes found in Bode diagrams are justified in theory. A method for the digitalization of an analog filter, both of first and second order, is given. Notation in the form of state equations for a numerical filter is discussed. Resultant analog characteristics for a filter (alpha, beta) are compared with those of a corresponding filter (alpha, beta, gamma) and a relationship between the respective noise for each system is shown. Author (ESA)

N81-17806# Stichting Mathematisch Centrum, Amsterdam (Netherlands). Dept. of Operations Research.
THE P-MEDIAN PROBLEM WITH MUTUAL COMMUNICATION ON A TREE
Antoon Kolen Nov. 1979 14 p refs Submitted for publication
(MC-BW-114/79) Avail: NTIS HC A02/MF A01; Stichting Math. Centrum, Amsterdam FL 3

The problem of locating p new facilities on a tree was studied, where each vertex represents an existing facility, in order to minimize the total weighted sum of distances between all pairs of new and existing facilities and between all pairs of new facilities. A polynomial-time algorithm for its solution is presented. This algorithm generalizes the well-known algorithm for the 1 median problem on a tree. Author (ESA)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N81-17807# Aerospace Corp., El Segundo, Calif. Satellite Navigation Dept.
ON THE INTERPRETATION OF ERROR CONTOURS Final Report
R. H. Gersten 30 Sep. 1980 24 p refs
(Contract F04701-79-C-0080)
(AD-A092896; TR-0080(5901-03)-2; SD-TR-80-83) Avail: NTIS HC A02/MF A01 CSCL 12/1

Although frequently encountered in engineering problems, the meaning of error contours has been the subject of much debate and confusion among engineers. This report attempts to clarify this situation by developing results from first principals without rigorous derivation. While the material presented here may be well known among a miniscule clique of theorists, it appears that this exposition is required by the engineering community. GRA

N81-17808# South Carolina Univ., Columbia. Dept. of Mathematics and Statistics.
ON THE SOLUTION OF A CLASS OF STOCHASTIC INTEGRAL SYSTEMS Interim Report
A. N. Rao Nov. 1980 26 p refs
(Contract F49620-79-C-0140; AF Proj. 2304)
(AD-A093183; TR-68; AFOSR-80-1298TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

General stochastic integral systems involving McShane integrals are studied. These systems include classes of stochastic integro-differential systems. Existence, uniqueness, and stability of solutions to such systems are investigated using contractor theory. In particular, the results yield frequency-type conditions for the stability of a class of stochastic systems. GRA

N81-17809# California Univ., Davis. Intercollege Div. of Statistics.
MODELING AND INFERENCE FOR POSITIVELY DEPENDENT VARIABLES IN DICHOTOMOUS EXPERIMENTS Interim Report
Russell A. Boyles and Francisco J. Samaniego Aug. 1980 39 p refs
(Grant AF-AFOSR-3180-77; AF Proj. 2304)
(AD-A093148; TR-19; AFOSR-80-1160TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Multivariate models with positively correlated components have found wide applicability in reliability and biostatistics. Perhaps the best known and most widely used such model is the multivariate exponential distribution due to Marshall and Olkin (JASA, 1967). We study a discrete analogue of the latter model. Specifically, we consider a model for random vectors Y whose components are positively correlated and have Bernoulli marginal distributions. The construction of the model reflects the fact that the k component system under study may be subjected to independent shocks selectively fatal to any subset of components. A special representation of the probability functon of Y is developed which proves useful in the inference questions pursued. While maximum likelihood estimation of the model parameters proves intractable, we obtain in closed form an alternative estimator which we show to be asymptotically equivalent to the MLE and, in fact, equals the MLE with limiting probability one. Similar results are obtained for a natural submodel whose parameter space is of substantially lower dimension. A Monte Carlo study sheds light on the sample size needed for the asymptotic results to take hold. GRA

N81-17810# California Univ., Davis. Intercollege Div. of Statistics.
MAXIMUM LIKELIHOOD ESTIMATION FOR A DISCRETE MULTIVARIATE SHOCK MODEL Interim Report
Russell A. Boyles and Francisco J. Samaniego Aug. 1980 23 p refs
(Grant AF-AFOSR-3180-77; AF Proj. 2304)
(AD-A093149; TR-21; AFOSR-80-1158TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A k-variate Bernoulli distribution with k-1 parameters is obtained as a shock model in which shocks are fatal to single components only or to all components simultaneously in a k-component system. The maximum likelihood estimator for model parameters if fully characterized. A simple iterative scheme is investigated, and it is shown that the scheme converges to the MLE for any seed in an interval whose endpoints depend only on the observed sample. GRA

N81-17811# California Univ., Davis. Intercollege Div. of Statistics.
ESTIMATING A DISTRIBUTION FUNCTION WHEN NEW

IS BETTER THAN USED Interim Technical Report
Francisco J. Samaniego and Russell A. Boyles Sep. 1980 29 p refs
(Grant AF-AFOSR-3180-77; AF Proj. 2304)
(AD-A093150; TR-22; AFOSR-80-1159TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The problem we study in this paper is the estimation of the distribution function F under the assumption that F belongs to the class of NBU distributions. Without the NBU restriction, the empirical distribution function F(n) converges to F in several senses and at the best possible rate. However, F(n) need not to be NBU, and, in fact, it is not difficult to show that P(f(n)) is NBU going to 0 when sampling from some NBU distributions (for example, the exponential distribution). Our goal here is to construct a sequence (F(n)) of NBU distributions which achieve the same asymptotic optimality as the sequence (F(n)). GRA

N81-17812# Naval Postgraduate School, Monterey, Calif.
MATHEMATICAL MODELS FOR OPERATIONAL AVAILABILITY Ph.D. Thesis
Man Won Jee Sep. 1980 165 p refs
(AD-A093257) Avail: NTIS HC A08/MF A01 CSCL 12/1

The point availability of a system of components each of which is subject to random failures and has random restoration times is determined. Each component is assumed to have a fixed number of spares such that when all spares are exhausted no restoration can take place. Exact expressions are obtained for the availability of any series/parallel system composed of independently operating components. Furthermore, expressions are obtained for the availability of series systems under five operating scenarios for which components are not independent. Order relationships on system availability for the various operating scenarios are determined. An algorithm which optimally allocates spare parts over the components in a system is presented. The algorithm offers computational savings over solutions derived from dynamic programming. GRA

N81-17813# Army Aviation Research and Development Command, St. Louis, Mo.
PROBABILISTIC ESTIMATES WITH LIMITED DATA Final Report
Conrad W. Faber Nov. 1980 43 p refs
(AD-A093969; USAAVRADCOM-TM-81-F-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

Decision makers require and need more than a point estimate of the cost and schedule for new or on-going programs. Much has been written about how to quantify program risks based upon historical data. However, estimates for new systems frequently depend upon expert opinion from a few knowledgeable persons because an applicable historical data base is not available. The method proposed in this report utilizes a PERT type network, beta distribution parameters for expert opinion inputs, and convolution of activity distributions by simulation. GRA

N81-17814# Florida State Univ., Tallahassee. Dept. of Statistics.
SELECTING ALL TREATMENTS BETTER THAN A CONTROL USING EXISTING TABLES
Roger L. Berger Oct. 1980 17 p refs
(Grant DAAG29-79-C-0158)
(AD-A093710; FSU-STATISTICS-M660; D-49-ARO; ARO-16713.13-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper subset selection procedures for selecting all treatment populations with means larger than a control population are proposed. The treatments and control are assumed to have a multivariate normal distribution. Various covariance structures are considered. All of the proposed procedures are easily implemented using existing tables of the multivariate normal and multivariate t distributions. Some other procedures which have been proposed require extensive and unavailable tables for their implementation. GRA

N81-17815# University of Southern California, Los Angeles. Dept. of Industrial and Systems Engineering.
THE ONE-ON-ONE STOCHASTIC DUEL, PART 3 Final Technical Report
C. J. Ancker, Jr. 15 Nov. 1980 275 p
(Contract DAAG29-78-C-0012)
(AD-A093866; ISE-TR-80-1-Pt-3; ARO-15084.3-M) Avail: NTIS HC A12/MF A01 CSCL 12/1

This report is the second and final half of a project to exhaustively review the literature of one on one stochastic duels. This part contains a comprehensive compendium of all results contained in papers which were previously listed in the annotated bibliography of the preceding report. The results are given in a common notation and are systematically organized. GRA

N81-17816# California Univ., Berkeley. Operations Research Center.
APPROACHES TO INVERSE LINEAR REGRESSION
R. Avenhaus, E. Hoepfinger (Kernforschungsanlage), and W. S. Jewell Oct. 1980 34 p refs Revised Prepared in cooperation with Kerforschungszentrum
(Grant AF-AFOSR-3179-77; AF Proj. 2304)
(AD-A093787; ORC-80-21; KFK-3007) Avail: NTIS HC A03/MF A01 CSCL 12/1

Many measurement problems can be formulated as follows: first, a certain linear relationship between two variables is to be estimated by using pairs of input and output data; thereafter, the value of an unknown input variable is to be estimated given an observation of the corresponding output variable. This problem is often referred to as inverse regression or discrimination. In this paper first non-Bayesian approaches to the problem, thereafter the Bayesian approach by Hoadley are presented. Third, a Bayesian approach by Avenhaus and Jewell is discussed which uses the ideas of credibility theory. Finally, a new Bayesian approach is presented. The advantages and disadvantages of the various approaches are put together. GRA

N81-17817# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
A TUTORIAL ON MARKOV RENEWAL THEORY SEMI-REGENERATIVE PROCESSES AND THEIR APPLICATIONS Interim Report
Ralph L. Disney Dec. 1980 108 p refs
(Contract N00014-77-C-0743; Grant NSF ENG-77-22757; NR Proj. 042-296)
(AD-A093679; VTR-80-07) Avail: NTIS HC A06/MF A01 CSCL 12/1

This is a tutorial paper on Markov renewal processes, semi-regenerative processes and their applications to many fields of interest. It was presented in the tutorial sessions of the O.R.S.A./T.I.M.S. meetings in Colorado Springs, November, 1980. The paper reviews the basic ingredients of the processes discussed, such as: structure of the process, semi-Markov kernels, Markov renewal functions, and integral equations of semi-regenerative processes. Considerable time is spent discussing several applications to combat line-of-sight, queueing, policy medical emergency systems, disease modelling, power generator reliability and worker fatigue. The bibliography of 21 items provides further readings for the beginner to pursue these topics. GRA

N81-17818# Wisconsin Univ. - Madison. Mathematics Research Center.
TWO-LEVEL MULTIFACTOR EXPERIMENT DESIGNS FOR DETECTING THE PRESENCE OF INTERACTIONS
Max D. Morris and Toby J. Mitchell Aug. 1980 49 p refs
(Contracts DAAG29-75-C-0024; DAAG29-80-C-0041; W-7405-eng-26)
(AD-A093573; MRC-TSR-2112) Avail: NTIS HC A03/MF A01 CSCL 12/1

A design optimality criterion tr(L) - optimality is applied to the problem of designing two-level multifactor experiments to detect the presence of interactions among the controlled variables. Rules are given for constructing tr(L) - optimal foldover designs and tr(L) - optimal fractional factorial designs. Some results are given on the power of these designs for testing the hypothesis that there are no two-factor interactions. Modifications of the tr(L) - optimal designs to satisfy other experimental objectives (estimability of effects, detection of the presence of other nonlinear effects, estimation of the error variance) are suggested. Examples are given to demonstrate the application of these designs to (1) screening for interactions, and (2) evaluating the first-order assumption in the sensitivity analysis of a computer code. GRA

N81-17819# Wisconsin Univ. - Madison. Mathematics Research Center.

SMOOTHING ESTIMATION OF STOCHASTIC PROCESSES. PART 1: CHANGE OF INITIAL CONDITION FORMULAE Summary Report

V. Solo Sep. 1980 35 p refs
(Contract DAAG29-80-C-0041)
(AD-A093633; MRC-TSR-2119) Avail: NTIS HC A03/MF A01 CSCL 12/1

Recently a great amount of attention has been focused on various algorithms for solving the smoothing problem of linear estimation theory. This work is the first part of a two part investigation of these algorithms. In Part 1 it is shown how change of initial condition (CIC) or partitioning formulae hold in a very general setting (the CIC problem is shown to involve fixed rank perturbation in matrix inversion). In Part 2 the nature of the two-filter algorithms is explored by providing a simple derivation that shows to what extent the formulae hold generally and so reveals exactly how a wide sense Markovian assumption is necessary for their full utility. The remainder of the paper is structured as follows. Section 1 contains a discussion of CIC formulae for discrete observations. Section 2 concerns CIC formulae for continuous observations (actually the formulae are the same). Section 3 discusses the relation with other work. GRA

N81-17820# Wisconsin Univ. - Madison. Mathematics Research Center.

SMOOTHING ESTIMATION OF STOCHASTIC PROCESSES. PART 2: TWO FILTER FORMULAE Summary Report

V. Solo Sep. 1980 25 p refs
(Contract DAAG29-80-C-0041)
(AD-A093634; MRC-TSR-2120) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this article these two filter results and some new ones are derived in a simple way in a very general setting (for arbitrary nonstationary processes). It turns out however that only if a wide-sense (i.e. second order) Markovian assumption is added can one of the filters be viewed as a backwards filter. The remainder of the paper is organized as follows. Section 2 recalls some smoothing formulae that apply to both continuous and discrete observations. Section 3 discusses two types of two filter-like formulae for general nonstationary processes. In Section 4 one of the filters is shown to be a backwards least squares estimate provided a wide sense Markovian assumption is satisfied. Section 5 contains a derivation of some backwards filters. In Section 6 some additional two filter-like formulae are given. The final section is a conclusion. GRA

N81-17821# Pittsburgh Univ., Pa. Dept. for Mathematics and Statistics.

ENTROPY DIFFERENTIAL METRIC, DISTANCE AND DIVERGENCE MEASURES IN PROBABILITY SPACES: A UNIFIED APPROACH Interim Report

J. Burbea and C. Radhakrishna Rao Oct. 1980 38 p refs
(Contract F49620-79-C-0161; AF Proj. 2304)
(AD-A093875; TR-80-18; AFOSR-80-1374TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The paper is devoted to metrization of probability spaces through the introduction of a quadratic differential metric in the parameter space of the probability distributions. For this purpose, a thi-entropy functional is defined on the probability space and its Hessian along a direction of the tangent space of the parameter space is taken as the metric. The distance between two probability distributions is computed as the geodesic distance induced by the metric. The paper also deals with three measures of divergence between probability distributions and their interrelationships. GRA

N81-17822# Pittsburgh Univ., Pa. Dept. of Mathematics and Statistics.

ASYMPTOTIC JOINT DISTRIBUTION OF FUNCTIONS OF THE ELEMENTS OF SAMPLE COVARIANCE MATRIX Interim Report

C. Fang Oct. 1980 28 p refs Prepared in cooperation with Carnegie-Mellon Univ., Pittsburgh, Pa. Submitted for publication
(Contract F49620-79-C-0161; AF Proj. 2304)
(AD-A093844; TR-80-22; AFOSR-80-1345TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper, the authors give asymptotic expressions for the joint distribution of the functions of the elements of the sample covariance matrix and sample correlation matrix in the noncentral cases when the underlying distribution is multivariate normal. Accuracy of the above expressions is also studied. Also, asymptotic expressions are given for functioning of the elements of the sample covariance matrix for nonnormal populations. Finally, some application of the above results are discussed. GRA

N81-17823# White Sands Missile Range, N.Mex. Data Sciences Div.

ROBUST FILTERING AND SMOOTHING VIA GAUSSIAN MIXTURES

William S. Agee and Barbara A. Dunn Dec. 1980 35 p refs
(AD-A093543; WSMR-TR-73) Avail: NTIS HC A03/MF A01 CSCL 12/1

Robust methods provide a fresh approach to the treatment of outliers in filtering and smoothing applications. In deriving the filter and smoother equations via the conditional mean formulation or maximum a posteriori formulation the measurement noise probability density is replaced by a pseudo density which is Gaussian mixture with very heavy tails. The resulting robust filter and smoother are applied to tracking data to obtain improved estimation performance in the presence of outliers. The improvement in estimation performance is evaluated by Monte Carlo using simulated tracking data. The Monte Carlo results indicate the improvement in performance to be somewhat greater than the improvement obtained when using robust filters and smoothers derived from M-estimates. GRA

N81-17824# Wisconsin Univ. - Madison. Mathematics Research Center.

ON LIMITS OF MULTIVARIATE B-SPLINES Summary Report

Wolfgang Dahmen (Bonn Univ.) and Charles A. Micchelli (IBM Watson Research Center) Sep. 1980 36 p refs
(Contract DAAG29-80-C-0041)
(AD-A093628; MRC-TSR-2114) Avail: NTIS HC A03/MF A01 CSCL 12/1

B-splines occupy a pivotal position in the theory of univariate spline functions. They offer a firm basis for many of the attractive theoretical and practical properties of splines. Therefore any advance in our knowledge concerning the multivariate B-spline should be of some value. The purpose of this paper is to investigate another aspect of multivariate B-splines. We succeed in identifying those distribution functions which are limits of multivariate B-splines (Polya distributions). This question was solved in one dimension by Curry and Schoenberg. Some properties of Polya distributions on Rs are also discussed. GRA

N81-17825# Wisconsin Univ. - Madison. Mathematics Research Center.

OPTIMAL UPPER CONFIDENCE LIMITS FOR PRODUCTS OF POISSON PARAMETERS WITH APPLICATIONS TO THE INTERWALL ESTIMATION OF THE FAILURE PROBABILITY OF PARALLEL SYSTEMS

Bernard Harris and Andrew P. Sons Sep. 1980 28 p refs
(Contracts DAAG29-80-C-0041; N00014-79-C-0321)
(AD-A093636; MRC-TSR-2122) Avail: NTIS HC A03/MF A01 CSCL 12/1

The problem of obtaining optimal upper confidence limits for systems of independent parallel components is treated. Exact optimal upper confidence limits are obtained for an arbitrary number of components for specified failure combinations. For a small number of failures, bounds on the upper confidence limits are obtained. For an arbitrary number of failures an approximation is given which is justified numerically and asymptotically. The results of this paper are compared with the results given by Buehler (1957) and some numerical examples are presented. GRA

N81-17826# Wisconsin Univ. - Milwaukee. Mathematics Research Center.

THE UBIQUITOUS ROLE OF F PRIME/F IN EFFICIENCY ROBUST ESTIMATION OF LOCATION

Brian L. Joiner and David L. Hall (Battelle Northwest Labs.,

Richland, Wash.) Aug. 1980 41 p refs
(Contracts DAAG29-75-C-0024; DAAG29-80-C-0041)
(AD-A093563; MRC-TSR-2102) Avail: NTIS
HC A03/MF A01 CSCL 12/1

This paper is primarily expository in nature and focuses on the all pervasive importance of f/f in efficient estimation of location, with primary emphasis on the role of f/f in robust estimation. Connections between M estimators (maximum likelihood-like), r (RANK) estimators and L estimators (linear explanation of f/f is given showing why it is an intuitively reasonable quantity on which to base estimation. The asymptotic relative efficiency of each class of estimators is shown to be the square of a correlation coefficient related to f/f and reasons are given as to why R estimators might often prove to have superior robustness properties relative to L and M estimators.
Author (GRA)

N81-17827# Wisconsin Univ. - Madison. Mathematics Research Center.

BOUNDS FOR THE t-TAIL AREA FOR ARBITRARY DEGREES OF FREEDOM

Andrew P. Soms Aug. 1980 15 p refs
(Contract DAAG29-80-C-0041)
(AD-A093566; MRC-TSR-2105) Avail: NTIS
HC A02/MF A01 CSCL 12/1

The bounds of Birnbaum (1942) and Sampford (1953) for the upper tail area of the normal distribution are extended to the upper tail of the t-distribution for arbitrary real degrees of freedom. This generalizes the results of Soms (1977a) for integral degrees of freedom. Numerical and theoretical comparisons are made with the bounds of Peizer and Pratt (1968), Wallace (1959) and Soms (1977b). GRA

N81-17828# Wisconsin Univ. - Madison. Mathematics Research Center.

A NOTE ON AN EXTENSION OF RATIONAL BOUNDS FOR THE t-TAIL AREA TO ARBITRARY DEGREES OF FREEDOM

Andrew P. Soms Aug. 1980 11 p refs
(Contract DAAG29-80-C-0041)
(AD-A093567; MRC-TSR-2106) Avail: NTIS
HC A02/MF A01 CSCL 12/1

Real degrees of freedom arise in the modification of the two-sample t-test when the variances cannot be assumed to be equal. For small degrees of freedom both linear interpolation and standard computer routines may be unsatisfactory. The present paper provides a simple technique for satisfactory estimates of tail probabilities. GRA

N81-17829# Wisconsin Univ. - Madison. Mathematics Research Center.

THE CONVERGENCE OF AN INSTRUMENTAL-VARIABLE LIKE RECURSION Summary Report

V. Solo Sep. 1980 16 p refs
(Contract DAAG29-80-C-0041)
(AD-A093632; MRC-TSR-2118) Avail: NTIS
HC A02/MF A01 CSCL 12/1

For the prediction of signals in real time it is often necessary to estimate the parameters of a signal model in real time. A large number of these so called recursive parameter estimation schemes have been suggested and the basic question for these schemes is whether or not they converge and whether they have to be monitored to ensure they do. This work deals with the convergence analysis of one (of only two known) particular recursion(s) that does not require monitoring. GRA

N81-17830# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

SPECTRAL ANALYSIS OF STOCHASTIC PROCESSES BY PREDICTION METHODS

W. Brandenburg Oct. 1979 27 p refs In GERMAN; ENGLISH summary
(Contract BMVg-GF-79; T/RF-37/71501/71300)
(Rept-7/79) Avail: NTIS HC A03/MF A01

An extension of the maximum entropy method is presented. The power spectrum of lines in white noise is fitted to a rational function of degree d. A justification of why rational functions are best suited for estimating the power spectrum is given. After some remarks on the principles of prediction theory, spectral analysis using various prediction methods is described. Nonlinear programming is used to find the minimal prediction error. Results show that the method of stochastic approximation is best for the analysis of nonstationary processes if the mean values do not change too fast. Simulation results of spectral analysis (stationary and nonstationary processes) illustrate the method.
Author (ESA)

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N81-17831*# Booz-Allen Applied Research, Inc., Bethesda, Md.

STUDY OF CIVIL MARKETS FOR HEAVY-LIFT AIRSHIPS

Peter Mettam, Dagfinn Hansen, Charles Chabot, and Robert Byrne Dec. 1978 390 p refs
(Contract NAS2-9826)
(NASA-CR-152202) Avail: NTIS HC A17/MF A01 CSCL 12B

The civil markets for heavy lift airships (HLAs) were defined by first identifying areas of most likely application. The operational suitability of HLAs for the applications identified were then assessed. The operating economics of HLAs were established and the market size for HLA services estimated by comparing HLA operating and economic characteristics with those of competing modes. The sensitivities of the market size to HLA characteristics were evaluated and the number and sizes of the vehicles required to service the more promising markets were defined. Important characteristics for future HLAs are discussed that were derived from the study of each application, including operational requirements, features enhancing profitability, military compatibility, improved design requirements, approach to entry into service, and institutional implications for design and operation. T.M.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N81-17832# Colorado Univ. at Boulder. Dept. of Computer Science.

A NEW DERIVATION OF SYMMETRIC POSITIVE DEFINITE SECANT UPDATES Interim Technical Report

Robert B. Schnabel and J. E. Dennis, Jr. Aug. 1980 35 p refs Prepared in cooperation with Rice Univ., Houston, Tex.
(Contracts DAAG29-79-C-0023; DAAG29-79-C-0124; Grant NSF MCS-79-06671)
(AD-A093060; CU-CS-185-80; ARO-15809.2-M; ARO-17016.3-M) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper, we introduce a simple new set of techniques for deriving symmetric and positive definite secant updates. We use these techniques to present a simple new derivation of the BFGS update using neither matrix inverses nor weighting matrices. A related derivation is shown to generate a large class of symmetric rank two update formulas, together with the condition for each to preserve positive definiteness. We apply our techniques to generate a new projected BFGS update, and indicate applications to the efficient implementation of secant algorithms via the Cholsky factorization. GRA

N81-17833# Maryland Univ. -College Park. Inst. of Physical Science and Technology.

ON A DIMENSIONAL REDUCTION METHOD. THE OPTIMAL SELECTION OF BASIS FUNCTIONS

M. Vogelius and I. Babuska Apr. 1980 37 p refs Sponsored in part by Aarhus Univ., Denmark
(Contract N00014-77-C-0623)
(AD-A092999; BN-939) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper is the first in a series of three, which analyze an adaptive approximate approach for solving (n+1)- dimensional

boundary value problems by replacing them with systems of equations in n-dimensional space. In this approach, the unknown functions of (n+1)- variables are projected onto finite linear combinations of functions of just n-variables. This paper shows how the coefficients of these linear combinations can be chosen optimally. GRA

N81-17834# Illinois Univ. at Chicago Circle, Chicago. Dept. of Mathematics.

ON THE CONSTRUCTION OF BIB DESIGNS WITH VARIABLE SUPPORT SIZES Interim Report

A. Hedayat and H. L. Hwang Oct. 1980 37 p refs

(Grant AF-AFOSR-3050-76; AF Proj. 2304)

(AD-A093165; AFOSR-80-1194TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

A balanced incomplete block (BIB) design with b blocks is said to have support size b^* when exactly b^* of the b blocks is distinct. The importance and the applications of BIB designs with b^* b in design of experiments and controlled sampling were explained in detail in Foody and Hedayat (1977) and Wynn (1977). A method of constructing BIB designs with various support sizes from known designs is introduced. This method, together with another method called, 'trade-off' which was introduced by Heydayat and Li (1979) are utilized to construct BIB designs with v = 8, k = 4 in particular. A table of BIB designs with $14 < or = b^* < or = 70$, b^* not equal 15, 16, 17, 19 with v = 8 and k = 4 is included. GRA

N81-17835# Pittsburgh Univ., Pa. Inst. for Statistics and Applications.

ON THE CONVEXITY OF SOME DIVERGENCE MEASURES BASED ON ENTROPY FUNCTIONS Interim Report

J. Burbea and Rao C. Radhakrishna Sep. 1980 30 p refs

(Contract F49620-79-C-0161; AF Proj. 2304)

(AD-A093123; TR-80-13; AFOSR-80-1167TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Three measures of divergence between vectors in a convex set of an n-dimensional real vector space have been defined in terms of certain types of entropy functions, and their convexity property studied. Among other results, a classification of the alpha-order entropies is obtained by the convexity of these measures. These results have applications to the measurement of diversity of a discrete probability distribution and divergence between two distributions. GRA

N81-17836# California Univ., Santa Barbara. Inst. for Algebra and Combinatorics.

FOUNDATIONS OF EIGENVALUE DISTRIBUTION THEORY FOR GENERAL NONNEGATIVE MATRICES, STABILITY CRITERIA FOR HYPERBOLIC INITIAL-BOUNDARY VALUE PROBLEMS, EXACT EIGENVALUE COMPUTATIONS ON THE ILLIAC 4 Interim Report, 30 Sep. 1979 - 29 Sep. 1980

Marvin Marcus, M. Goldberg, M. Newman, R. C. Thompson, and Henry K. Minc 29 Sep. 1980 37 p refs

(Grant AF-AFOSR-0127-79; AF Proj. 2304)

(AD-A093184; AFOSR-80-1299TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This document summarizes 46 research papers which have either appeared or will appear in major referred publications. Highlights of some of the results include: (1) convenient stability criteria for difference approximations to hyperbolic initial boundary value problems have been obtained. The new criteria are given in terms of the boundary conditions and are independent of the basic scheme. (2) the known stability condition for the multi-dimensional Lax-Wendroff scheme has been improved. (3) norm properties of C-numerical radii were studied. In particular, multiplicativity factors were obtained for the case where C is a normal matrix. Also, the following computer codes written for the ILLIAC IV were completed: (1) a program to determine the rank and a maximal nonvanishing subdeterminant of an integral m X n matrix; (2) a program to determine the null space of an integral m X n matrix; and (3) a program to determine all the rational solutions of an arbitrary integral linear system of equations. GRA

N81-17837# South Carolina Univ., Columbia. Dept. of Mathematics and Statistics.

STABILITY OF LINEAR FORMS IN INDEPENDENT RANDOM VARIABLES IN BANACH SPACES Interim Report

Joe Howell, Robert L. Taylor, and Wojbor A. Woyczynski Nov. 1980 19 p refs Prepared in cooperation with Cleveland State Univ.

(Contract F49620-79-C-0140; AF Proj. 2304)

(AD-A093445; TR-67; AFOSR-80-1297TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

In the present paper, we study the almost sure stability and the stability in probability of linear forms in independent random vectors taking values in a real separable Banach space. GRA

N81-17838# Stanford Univ., Calif. Systems Optimization Lab.

WORST CASE ANALYSIS OF GREEDY HEURISTICS FOR INTEGER PROGRAMMING WITH NON-NEGATIVE DATA

Greg Dobson Oct. 1980 27 p refs

(Contracts N00014-75-C-0267; DE-AC03-76SF-00326; DE-AT03-76ER-72018; Grants NSF MCS-76-81259; NSF MCS-79-26009; NSF ENG-77-06761)

(AD-A093618; SU-SOL-80-25) Avail: NTIS HC A03/MF A01 CSCL 12/1

We give a worst case analysis for two greedy heuristics for the integer programming problem minimize cx, Ax > or = b, 0 < or = x < or = u, x integer, where the entries A, b, and c are all non-negative. The first heuristic is for the case where the entries in A and b are integral, the second only assumes the rows are scaled so that the smallest nonzero entry is at least 1. In both cases we compare the ratio of the value of the greedy solution to that of the integer optimal. The error bound grows logarithmically in the maximum column sum of A for both heuristics. GRA

N81-17839# Maryland Univ., College Park. Dept. of Physics and Astronomy.

COMPUTER-AIDED CLOSURE OF THE LIE ALGEBRA ASSOCIATED WITH A NONLINEAR PDE

Allan Reiman Oct. 1980 21 p refs

(Contract DE-AC05-79ET-53044)

(AD-A093640; PUB-81-092; PL-81-020) Avail: NTIS HC A02/MF A01 CSCL 12/1

Since the solution of the KdV equation by Gardner, Greene, Kruskal and Miura in 1967, the inverse scattering method which they discovered has been extended to solve a large class of nonlinear PDE's. However, a method for seeking an inverse scattering solution to a given equation has emerged from the work of Wahlquist and Estabrook. The Wahlquist-Estabrook (WE) method systematically associates a set of Lie brackets with a given nonlinear PDE. If this Lie algebra can be closed, consistent with the Jacobi identity, then an associated linear representation gives the inverse scattering transform, when one exists. Even when an inverse scattering transform does not exist, if the Lie algebra can be closed the associated linear representation can provide useful information about the solutions of the nonlinear PDE. This task involves repeated application of the Jacobi identities, which in turn requires the evaluation of a large number of Lie brackets which must be looked up in a table. The simple but repetitive nature of this task suggests that we attempt to mechanize it using a computer. However, we must also require that our program automatically perform algebraic simplifications at each step: properly distributing the Lie bracket over a sum of terms, combining like terms, multiplying numerical coefficients, etc. We have therefore used the symbolic manipulation language MACSYMA to implement our algorithms. The language has built-in capabilities for performing the standard simple algebraic manipulations from which we build up our algorithms. GRA

N81-17840# Wisconsin Univ. - Madison. Mathematics Research Center.

A GENERALIZATION OF THE KREISS MATRIX THEOREM Summary Report

Shmuel Friedland Aug. 1980 15 p refs

(Contract DAAG29-80-C-0041)

(AD-A093569; MRC-TSR-2108) Avail: NTIS HC A02/MF A01 CSCL 12/1

In the early sixties, H. O. Kreiss, while studying stability of numerical schemes for partial differential equations, considered a generalization of a problem. Namely, given a set A of n x n

complex valued matrices, when all powers of A epsilon A are uniformly bounded. These sets, called the stable sets, were completely characterized by Kreiss by giving three equivalent conditions. In this paper we consider alpha-stable sets A (alpha greater than 0), such that for any A epsilon A the powers A to the Nu power are uniformly bounded by K nu to the alpha power. We generalize the Kreiss resolvent condition for alpha-stable sets. It seems that alpha-stable sets are related to the concept of weakly stable numerical schemes for partial differential equations. GRA

N81-17841# Wisconsin Univ. - Madison. Mathematics Research Center.

***SHARP EXISTENCE RESULTS FOR A CLASS OF SEMILINEAR ELLIPTIC PROBLEMS* Summary Report**

H. Berestycki and P. L. Lions Aug. 1980 20 p refs

(Contract DAAG29-80-C-0041)

(AD-A093572; MRC-TSR-2111) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper a semilinear elliptic second-order problem is considered. Under very general assumptions, we give a precise description of the number of solutions of the problem. GRA

N81-17842# Wisconsin Univ. - Madison.

***HAUSDORFF'S MOMENT PROBLEM AND EXPANSIONS IN* LEGENDRE POLYNOMIALS**

R. Askey, I. J. Schoenberg, and A. Sharma Oct. 1980 15 p refs

(Contract DAAG29-80-C-2130)

(AD-A093612; MRC-TSR-2130) Avail: NTIS HC A02/MF A01 CSCL 12/1

A new proof is given for Hausdorff's condition on a set of moments which determines when the function generating these moments is in L2. The proof uses Legendre polynomials and their discrete extensions found by Tchebychef. Then an extension is given to a weighted L2 space using Jacobi polynomials and their discrete extensions. GRA

N81-17843# Wisconsin Univ. - Madison. Mathematics Research Center.

A CHARACTERIZATION OF NORMAL OPERATORS

Shmuel Friedland (Hebrew Univ., Jerusalem) and Luc C. Tartar (Paris Univ.) Oct. 1980 11 p

(Contract DAAG29-80-C-0041)

(AD-A093613; MRC-TSR-2132) Avail: NTIS HC A02/MF A01 CSCL 12/1

Let A be a bounded linear operator in a Hilbert space. If A is normal then log(absolute value of ((e to the At)u)) and log(absolute value of ((e to the A prime t)u)) are convex functions for all u not equal to 0. In this paper we prove that these properties characterize normal operators. GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N81-17844# National Academy of Sciences - National Research Council, Washington, D. C.

NUMERICAL DATA ADVISORY BOARD ASSEMBLY OF MATHEMATICAL AND PHYSICAL SCIENCES

30 Jul. 1980 18 p refs

(Contracts DE-AT02-79CH-93029; EY-76-C-02-2708)

(DOE/CH-93029/1) Avail: NTIS HC A02/MF A01

The Numerical Data Advisory Board (NDAB) is an advisory body that provides expert overview, on a broad basis, of data needs and data programs as required for the advancement of science and technology. Board members representing various disciplines concern themselves with the quality, reliability, availability, accessibility, and dissemination of numerical data in physical, chemical, engineering, and interdisciplinary subjects as well as numeric and non-numeric data that arise in biology and geology. Topics of concern are addressed by the NDAB membership, or by specific, carefully chosen committees and panels established by NDAB in order to include experts appropriate to the subject at hand. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see 45 Environment Pollution.

N81-17845*# *Old Dominion Univ., Norfolk, Va. Dept. of* Physics.

PROPAGATION OF SOUND THROUGH THE EARTH'S ATMOSPHERE. 1: MEASUREMENT OF SOUND ABSORPTION IN THE AIR. 2: MEASUREMENT OF GROUND IMPEDANCE *Final Report, 1 Jul. 1980 - 30 Jun. 1981*

Jacob Becher, Roger W. Meredith, and Allan J. Zuckerwar Jan. 1981 19 p refs

(Grant NAG1-15)

(NASA-CR-163958; PTR-81-4) Avail: NTIS HC A02/MF A01 CSCL 20A

The fabrication of parts for the acoustic ground impedance meter was completed, and the instrument tested. Acoustic ground impedance meter, automatic data processing system, cooling *system for the resonant tube, and final results of sound absorption* in N2-H2O gas mixtures at elevated temperatures are described. S.F.

N81-17846*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.

AERODYNAMIC/ACOUSTIC PERFORMANCE OF YJ101/ DOUBLE BYPASS VCE WITH COANNULAR PLUG NOZZLE *Final Report*

John W. Vdoviak, Paul R. Knott, and Jon J. Ebacker Jan. 1981 307 p refs

(Contract NAS3-20582)

(NASA-CR-159869; R80AEG369) Avail: NTIS HC A14/MF A01 CSCL 20A

Results of a forward Variable Area Bypass Injector test and a Coannular Nozzle test performed on a YJ101 Double Bypass Variable Cycle Engine are reported. These components are intended for use on a Variable Cycle Engine. The forward Variable Area Bypass Injector test demonstrated the mode shifting capability between single and double bypass operation with less than predicted aerodynamic losses in the bypass duct. The acoustic nozzle test demonstrated that coannular noise suppression was between 4 and 6 PNdB in the aft quadrant. The YJ101 VCE equipped with the forward VABI and the coannular exhaust nozzle performed as predicted with exhaust system aerodynamic losses lower than predicted both in single and double bypass modes. Extensive acoustic data were collected including far field, near field, sound separation/ internal probe measurements as Laser Velocimeter traverses. Author

N81-17847# Rome Air Development Center, Griffiss AFB, N.Y.

MICROWAVE ACOUSTICS HANDBOOK. VOLUME 4: BULK WAVE VELOCITIES: NUMERICAL DATA *Report, Nov. 1971 - Apr. 1980*

A. J. Slobodnik, Jr., R. T. Delmonico, and E. D. Conway Jun. 1980 337 p

(AF Proj. 2305)

(AD-A092957; RADC-TR-80-190) Avail: NTIS HC A15/MF A01 CSCL 20/1

Information useful for the design of acoustic delay lines, resonators, and other miniature, low-cost devices for use in communications and electronic sensing is given. Numerical data on bulk acoustic wave velocities and power flow angles are given for longitudinal, and two shear waves for various orientations of the following single crystalline materials: Ba2NaNb5O15, Bi12/geO20, CdS, Diamond, Eu3Fe5O15, GaAs, Gadolinium Gallium Garnet, Germanium, InSb, InAs, Lead Molybdate, PbS, LiNbO3, LiTaO3, MgO, Quartz, Rutile, Sapphire, Silicon, Spinel, TeO2, YAG, YGaG, YIG, and ZnO. This present volume is intended to be used as a supplement to Volume 3 whenever accurate numerical data is required rather than the more convenient graphical information. GRA

N81-17848# DyTec Engineering, Inc., Long Beach, Calif.

EVALUATION OF ALTERNATIVE PROCEDURES FOR ATMOSPHERIC ABSORPTION ADJUSTMENTS DURING NOISE CERTIFICATION. VOLUME 3: TABLES OF

ATMOSPHERIC ABSORPTION LOSSES Final Report
Alan H. Marsh Oct. 1980 65 p
(Contract DOT-FA78WA-4121)
(AD-A093144; DYTEC-7928; FAA-EE-80-46-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 20/1

The work reported here extends that in FAA-RD-77-167, December 1977, to the problem of adjusting actual aircraft noise 1/3 octave-band spectra measured at 0.5 s intervals. Test-day spectra are used to calculate, PNL, PNLT, EPNL, AL, and SEL. The test-day spectrum at the time of PNLTM and at the time of ALM are adjusted to acoustical-reference conditions using the atmospheric-absorption method in American National Standard ANS S1.26-1978 and applied, using measurements of air temperature and relative humidity at various heights above the ground, by integrating over the frequency range of the passband of ideal filters and by calculating the absorption at the exact band center frequencies only. SAE ARP866A is also used with the vertical-profile temperature/humidity data and with data at 10.0 m to determine adjustments from test to reference conditions. The adjustment methods are applied to noise data from 9 aircraft. Volume 1 describes the analyses and results of the study. Volume 2 presents the computer program that was developed and illustrates its use with a test case. Volume 3 presents tables of attenuation due to atmospheric absorption over a 300 m path. Attenuatons were calculated using ANS S1.26-1978 for pure tones at band center frequencies and for 3 noise spectral slopes by a band-integration method, and using SAE ARP866A. For each of the 5 methods, the tables cover 34 air temperatures from 2 to 35C, 10 relative humidities from 10 to 100 percent, and 24 nominal band center frequencies from 50 to 10,000 Hz. GRA

N81-17849# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
NOISECHECK PROCEDURES FOR MEASURING NOISE EXPOSURE FROM AIRCRAFT OPERATIONS Final Report
Dwight E. Bishop, Andrew S. Harris, Joan Mahoney, and Peter E. Rentz Nov. 1980 96 p
(Contract F33615-77-C-0514; AF Proj. 7231)
(AD-A093948; BBN-3869) Avail: NTIS HC A05/MF A01 CSCL 20/1

NOISECHECK is a measurement program used (1) when an engineer is uncertain about a Sound Exposure Level (SEL) resulting from a particular type of operation or (2) to check noise contours determined by NOISEMAP - an Air Force computer program. The file of aircraft noise data used by NOISEMAP is called NOISEFILE. The NOISECHECK measurement program uses portable noise monitors that measure Day-Night Sound Levels (DNLs) over one or more days as well as individual Sound Exposure Levels (SELs). The measured DNLs are then compared with the DNLs calculated by NOISEMAP, or they contribute SEL data for comparison with NOISEFILE. This report delineates the field test data acquisition and analysis procedures used to conduct NOISECHECK type measurement studies. A companion report, AMRL-TR-78-125, Development of NOISECHECK Technology for Measuring Aircraft Noise Exposure, describes the instrumentation development and subsequent field test conducted at Barksdale AFB as part of this research effort. GRA

N81-17850# Cambridge Acoustical Associates, Inc., Mass.
HIGH FREQUENCY ASYMPTOTICS AND THE TRANSITION MATRIX FORMULATION OF SCATTERING
Joel M. Garrelick Feb. 1980 31 p refs
(Contract N00014-78-C-1218)
(AD-A093455; CAA-U-659-260) Avail: NTIS HC A03/MF A01 CSCL 20/1

This report deals with the use of high frequency asymptotics to evaluate and possibly facilitate, the convergence of the transition matrix formulation of scattering. For illustrative purposes, elastic and acoustic scattering from spherical and spheroidal cavities is considered in some detail. References are presented for other types of inclusions. Finally, a general method is suggested for integrating high frequency asymptotic solutions into the T-matrix formulation itself with the purpose of improving convergence. The method is implemented for the case of a spherical, and a prolate, spheroidal cavity. GRA

N81-17851# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
HELICOPTER NOISE CONTOUR DEVELOPMENT TECHNIQUES AND DIRECTIVITY ANALYSIS
J. Steven Newman Sep. 1980 43 p refs
(AD-A093426; FAA-EE-80-41) Avail: NTIS HC A03/MF A01 CSCL 20/1

This paper briefly summarizes techniques which have been developed for use in creating helicopter air-to-ground, noise-distance relationships. Discussion is provided concerning FAA efforts to establish an accurate and practical method (which considers source directivity) for modeling the noise impact associated with helicopter operations. Plots of normalized directivity vectors are provided for eight helicopters in various modes of flight. GRA

N81-17852# Federal Aviation Administration, Washington, D.C. Office of Environment and Energy.
CORRELATION OF HELICOPTER NOISE LEVELS WITH PHYSICAL AND PERFORMANCE CHARACTERISTICS
J. Steven Newman Sep. 1980 31 p refs
(AD-A093428; FAA-EE-80-42) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report investigates the correlation between physical and performance characteristics of helicopters and the noise levels which they generate in various operational modes. The analysis is generally empirical although several theoretical functions described in the literature have been examined. The EPNL is the acoustical metric employed in this study. One, two, and three-step multiple regression analyses are conducted for takeoff, approach, and level flyover operations. Plots are provided for the three best single variable regression models for each mode of flight. GRA

N81-17853# DyTec Engineering, Inc., Long Beach, Calif.
EVALUATION OF ALTERNATIVE PROCEDURES FOR ATMOSPHERIC ABSORPTION ADJUSTMENTS DURING NOISE CERTIFICATION. VOLUME 2: COMPUTER PROGRAM Final Report
Alan H. Marsh Oct. 1980 98 p
(AD-A093267; DYTEC-7927-Vol-2; FAA-EE-80-46-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 20/1

The work reported here extends that in FAA-RD-77-167, December 1977, to the problem of adjusting actual aircraft noise 1/3-octave-band spectra measured at 0.5-s intervals. Test-day spectra are used to calculate, PNL, PNLT, EPNL, AL, and SEL. The test-day spectrum at the time of PNLTM and at the time of ALM are adjusted to acoustical-reference conditions using the atmospheric-absorption method in American National Standard ANS S1.26-1978 and applied, using measurements of air temperature and relative humidity at various heights above the ground, by integrating over the frequency range of the passband of ideal filters and by calculating the absorption at the exact band center frequencies only. SAE ARP866A is also used with the vertical-profile temperature/humidity data and with data at 10.0 m to determine adjustments from test to reference conditions. The adjustment methods are applied to noise data from 9 aircraft. Volume 1 describes the analyses and results of the study. Volume 2 presents the computer program that was developed and illustrates its use with a test case. Volume 3 presents tables of attenuation due to atmospheric absorption over a 300 m path. Attenuations were calculated using ANS S1.26-1978 for pure tones at band center frequencies and for 3 noise spectral slopes by a band-integration method, and using SAE ARP866A. For each of the 5 methods, the tables cover 34 air temperatures from 2 to 35C, 10 relative humidities from 10 to 100 percent, and 24 nominal band center frequencies from 50 to 10,000 Hz. GRA

N81-17854# Rolls-Royce Ltd., Derby (England). Noise Dept.
FAN NOISE SOURCE LOCATION FROM FIELD MEASUREMENTS
A. M. Cargill 1980 14 p refs Prepared in cooperation with Leeds Univ., England
(PNR-90045) Avail: NTIS HC A02/MF A01

Far-field duct mode fan noise detection and source location theory as well as experiments are studied. The effects of fan inlet ducting, far field sound and various ways of compensating for it are discussed. Problems of source location, such as the design of appropriate microphone arrays, are surveyed. Results

from tests on a model aircraft engine fan are described which show that while source location techniques which utilize far field microphone arrays work well in principle, there are serious problems limiting their application to real fans. These include the difficulty in accounting for propagation along the duct, and the presence of highly coherent tones in the far field fan noise signature. Author (ESA)

N81-17855# Rolls-Royce Ltd., Derby (England). Noise Dept.
THE RADIATION OF HIGH FREQUENCY SOUND FROM A JET PIPE
A. M. Cargill 1980 11 p refs Sponsored in part by UK Sci. Res. Council Prepared in cooperation with Leeds Univ., England (PNR-90046) Avail: NTIS HC A02/MF A01

The radiation of sound from a semi-infinite cylindrical pipe with internal and external flows is discussed. Two approximate solutions are presented, based on Kirchhoff diffraction theory and edge scattering, and are compared with an exact solution by the Wiener-Hopf technique. The radiation from a baffled opening with a jet pipe is also discussed. The differences between this simple model and an aircraft engine are compared showing how the results are modified by the presence of a secondary flow (eg. the fan stream on a turbofan engine), by the existence of a contracting nozzle, and by the scattering of the sound by jet shear layer turbulence. For the latter, results in excellent qualitative agreement with observations on real engines are obtained.
Author (ESA)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N81-17856# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.
A STUDY OF SECONDARY MOLECULAR ION FORMATION IN RARE EARTHS AND RARE EARTH OXIDES Interim Technical Report
D. T. Hodul, W. C. Harris, and G. H. Morrison 15 Dec. 1980 26 p refs Submitted for publication
(Contract N00014-80-C-0538)
(AD-A093064; TR-4) Avail: NTIS HC A03/MF A01 CSCL 07/4

Secondary atomic and molecular ion energy spectra have been obtained for several rare earth and rare earth oxide samples. The energy dependencies of the diatomic ions were found to be a product of the energy dependencies of the atomic ions. Qualitative agreement of this product rule is also found for larger clusters. A recombination mechanism for molecular formation is demonstrated to be consistent with these results. Several preliminary ion implant studies are presented to give further insight into the recombination model. GRA

N81-17857# Princeton Univ., N. J. Dept. of Chemistry.
STUDIES IN MOLECULAR COLLISION PHENOMENA Progress Report, 1 Nov. 1979 - 5 Dec. 1980
Herschel Rabitz 1980 17 p
(AD-A092930; PR-9) Avail: NTIS HC A02/MF A01 CSCL 07/4

Molecular dynamics studies at Princeton are reviewed. The areas of research involved are: molecular collisions, radiation-molecule interaction, sensitivity theory, and finite elements in quantum mechanics. GRA

N81-17858# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
ENERGY AND CHEMICAL CHANGE Final Report, 1 Nov. 1976 - 31 Oct. 1980
R. D. Levine and J. L. Kinsey Oct. 1980 11 p
(Grant AF-AFOSR-3135-77)
(AD-A093124; AFOSR-80-1224TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

The role of energy in molecular collisions and in systems in macroscopic disequilibrium can be compactly presented and discussed using surprisal analysis. A summary of four years of progress with special reference to the dynamical foundations and the predictive aspects is presented. A list of 35 articles and books in which the work described is delineated in detail is included. GRA

N81-17859# SRI International Corp., Menlo Park, Calif.
METASTABLE RARE GAS COLLISIONS WITH MOLECULES Progress Report, Nov. 1979 - Nov. 1980
Keith T. Gillen and D. C. Lorents 26 Nov. 1980 5 p
(Contract N00014-76-C-0734)
(AD-A093303) Avail: NTIS HC A02/MF A01 CSCL 07/4

The elastic, inelastic, and reactive scattering properties are being investigated. Attempts are being made to elucidate the factors important in determining competition between various alternative reaction pathways in these relatively complex systems. This report summarizes recent progress in an experimental and computer-modeling investigation of reactive and inelastic scattering of fast metastable rare gas atoms metastable helium and argon by various target molecules oxygen, iodine, and nitrogen oxide. GRA

N81-17860# Harry Diamond Labs., Adelphi, Md.
LINE BROADENING AND SHIFTS OF RARE-EARTH ION ENERGY LEVELS IN SOLIDS
Clyde A. Morrison and Richard P. Leavitt Nov. 1980 12 p refs Sponsored by Army Electronics Research and Development Command
(AD-A093107; HDL-TM-80-30) Avail: NTIS HC A02/MF A01 CSCL 07/4

A general theory of inhomogeneous line broadening of rare-earth ions in solids is developed. An application of the theory to stoichiometric rare-earth host materials is given. The theory as developed has definite computational advantages to workers who have the facilities for the calculation of crystal-field energy levels. GRA

N81-17861# Minnesota Univ., Minneapolis. Dept. of Chemistry.
SITE SYMMETRY OF SURFACE ADSORBED MOLECULES
Henry Nichols and Robert M. Hexter 15 Dec. 1980 46 p refs
(Contract N00014-77-C-0209)
(AD-A093804; TR-6) Avail: NTIS HC A03/MF A01 CSCL 07/4

A procedure for determining the allowed local site symmetry groups, S, for surface adsorbed molecules is presented. An analogy can be drawn between the perturbing field experienced by a matrix isolated molecule in a three dimensional crystal and that experienced by a molecule adsorbed on a surface. In the former case, the field has the symmetry of the host lattice site whereas in the latter case, the field has the symmetry of the adsite. The symmetry operations of the local site symmetry group, S, consist of an operation in the molecular point group, M, applied to the molecule combined with an operation in G applied to the substrate. A mapping of the operations in M and G operations in their isomorphous Longuet-Higgins groups allows the operations to be identified as permutation, P, or permutation-inversion, P^*, operations. The operations in M with P operations in G and of P^* operations in G. An adsorbed molecule having M = D sub 3h symmetry is used as an example to demonstrate the procedure for determining S. The local site symmetry group of the adsorbed molecule is, in general, different for the homogeneous surface approximation as opposed to the microscopic surface approximation. An attempt is made to apply predicted spectroscopic selection rules to adsorbed pyridine and ethylene. Several factors which complicate the interpretation of Raman spectra of molecules adsorbed on metal surfaces are discussed, one of these being depolarization effects due to rough surfaces. GRA

N81-17862# Naval Research Lab., Washington, D. C.
COOPERATIVE RADIATION EFFECTS SIMULATION PROGRAM Annual Progress Report, 1 Sep. 1978 - 31 Aug. 1979
L. A. Beach and F. A. Smidt, Jr. 16 Dec. 1980 63 p refs
(AD-A093743; NRL-MR-4379) Avail: NTIS HC A04/MF A01 CSCL 18/6

The Cooperative Radiation Effects Simulation Program (CORES) is a collaborative effort of the Material Science and Technology and the Radiation Technology Divisions of the NRL

Material Science and Component Technology Area. The goal of the research is to provide the theoretical and experimental bases for understanding the mechanisms of nuclear radiation damage of metals, as well as a theoretical insight into energy deposition processes. In this, the Van de Graaff and Cyclotron are used to simulate rapidly the radiation damage produced over long periods in reactor neutron environments. Progress for the period, 1 September 1978 to 31 August 1979, includes: (1) the effect of Ni ion bombardment on nickel and binary nickel alloys was investigated at 675 C, 625 C and 525 C and compared with neutron irradiation at 455 C; (2) the microstructures of titanium scoping alloys following low fluence neutron at 450 C were studied by transmission electron microscopy; and (3) X-ray diffraction measurements of early stages of radiation damage in metals was studied in single crystal and polycrystalline Cu specimens. GRA

N81-17863# California Univ., Berkeley. Electronics Research Lab.

NONLINEAR FREQUENCY SHIFT INDUCED BY THE LOWER HYBRID DRIFT INSTABILITY

Yu-Jiuan Chen and Bruce I. Cohen 1 Apr. 1980 28 p refs (Contracts N00014-77-C-0578; W-7405-eng-48)
(AD-A093380; UCB/ERL-M80/20) Avail: NTIS HC A03/MF A01 CSCL 20/8

A finite perturbation of the ion orbits leads to a nonlinear frequency shift that reduces the mode frequency and has a weak stabilizing effect on the lower-hybrid drift instability. This result is obtained from a self-consistent solution of the Vlasov-Poisson equations using perturbation theory in which the nonlinear dielectric function and the nonlinear temporal evolution of a single unstable mode in the low drift velocity regime are calculated analytically. GRA

N81-17864# Brookhaven National Lab., Upton, N. Y.

PRODUCTION OF NARROW ANTI PP STATES BY MESON EXCHANGE IN 10 Ge V PI IP INTERACTIONS

J. J. Russell, R. M. Bionta, A. S. Carroll, R. M. Edelstein, D. R. Green, E. J. Makuchowski, S. P. Morrissey, J. S. Russ, N. Sharfman, and R. B. Sutton 1980 9 p Presented at the 5th European Symp. on Nucleon-Antinucleon Interactions, Bressanone, Italy, 23-28 Jun. 1980 Prepared in cooperation with Southeastern Mass. Univ., and Carnegie-Mellon Univ. and Fermi Natl. Accelerator Lab.
(Contract DE-AC02-76CH-00016)
(BNL-28254; CONF-800688) Avail: NTIS HC A02/MF A01

The possibility of producing narrow baryonium states is pi(+)p collisions in the forward direction is investigated. It is concluded that no narrow and pp states are produced in pi(+)p yielding anti-pp pi(+)p in the mass range 1.9 to 2.5 GeV with cross sections above approximately 20 nb. DOE

N81-17865# New Mexico Univ., Albuquerque.

SEARCH FOR NARROW ANTI NN STATES IN ANTI pd ANNIHILATION

C. Amsler, L. B. Auerbach (Temple Univ.), B. D. Dieterle, J. Donahue, N. Haik (Temple Univ.), C. C. Hermann, V. L. Highland (Temple Univ.), E. Jastrzembski, C. P. Leavitt, M. A. Mandelkern et al 1980 8 p refs Presented at 5th European Symp. on Nucleon-Antinucleon Interactions, Bressanone, Italy, Jun. 1980
(Contract DE-AS02-76ER-03539)
(CONF-800688-5) Avail: NTIS HC A02/MF A01

An anti-pd yields NX missing-mass experiment was performed, and the invariant mass of the system X (anti-pp or anti-pn) was determined at 500 and 610 MeV/c beam momenta by measurement of the angle and time of flight of the recoiling nucleon. Possible radiative transitions in anti-pd yields NX gamma were also investigated with a large NaI crystal. For annihilations at rest a 4 standard deviation upper limit of 0.3% was found for the production of narrow bound states; for annihilations in flight the limit was 2 mb in the mass interval 1650 to 1930 MeV/sq c (for isotropic production in the anti-pd center of mass system). Missing mass and photon energy distributions are shown. The mean number of photons per annihilation was 2.6 + or - 0.3, in agreement with a neutral to charged pion ratio of 0.5 predicted by charge independence. DOE

N81-17866# Stanford Linear Accelerator Center, Calif.

PARTICLE IDENTIFICATION BY CHERENKOV AND TRANSITION RADIATION

R. S. Gilmore Sep. 1980 40 p refs Presented at the Prog. of the Summer Inst. on Particle Phys., Stanford, Calif., 28 Jul. - 8 Aug. 1980 Sponsored in part by Bristol Univ., England
(Contract DE-AC03-76SF-00515)
(SLAC-PUB-2606) Avail: NTIS HC A03/MF A01

The role of the Cherenkov counter as a particle identifier for velocities which are too high for Time-of-Flight to be used, and too low for transition radiation detectors to give a useable signal is discussed. In beam lines the compensated differential counter is capable of giving the best resolution, but at high momenta the restriction on the spread of particle directions gives unacceptable limits on the beam acceptance. The transition radiation detectors developed to identify hadrons at relatively low mementum do not have this restriction and might be used instead. For particles produced in an interaction, the ring imaging type of Cherenkov should give the best coverage for multiparticle events, but a threshold counter is much simpler, cheaper, and faster where it can give adequate separation. Again at high values of gamma the resolution of Cherenkov counters fail and some form of transition radiation detector is necessary. DOE

N81-17867# Temple Univ., Philadelphia, Pa. Dept. of Physics.

SEARCH FOR STRUCTURE IN THE LOW-ENERGY ANTI p-p ANNIHILATION CROSS SECTION

E. Jastrzembski, N. Haik, W. K. McFarlane, M. A. Mandelkern (California Univ., Irvine), D. C. Schultz (California Univ., Irvine), C. Amsler (New Mexico Univ., Albuquerque), C. C. Hermann (New Mexico Univ., Albuquerque), and D. M. Wolfe (New Mexico Univ., Albuquerque) 1980 9 p refs Presented at 5th European Symp. on Nucleon-Antinucleon Interactions, Bressanone, Italy, Jun. 1980
(Contract DE-AS02-76ER-03539)
(CONF-800688-6) Avail: NTIS HC A02/MF A01

The relative cross section for annihilation of antiprotons on hydrogen into one or more charged pions was measured. Incident beam momentum was 600 MeV/c. Numbers of observed events (relative) were compared with those expected from the sensitivity of the apparatus. A phase space model was used for p-barp annihilation. Relative cross sections are plotted vs invariant mass. Upper limits on cross sections for the formation of narrow resonances in the S region are given; previously reported structures are not confirmed. DOE

N81-17868# Virginia Univ., Charlottesville. Dept. of Physics.

EXPERIMENTS ON THE NUCLEAR INTERACTION OF PIONS Progress Report, 1 Dec. 1979 - 30 Nov. 1980

R. C. Minehart and K. O. H. Ziock 1980 18 p
(Contract EY-76-S-05-4043)
(ORO-4043-40) Avail: NTIS HC A02/MF A01

The status of the following experiments is reported: pi(+) + d yields 2p; pion elastic scattering on deuterium pion elastic and quasielastic scattering from He-3 and He-4; pion double charge exchange in He isotopes and quasielastic scattering of pions on carbon. Several other experiments are proposed. Cross sections are shown for pion scattering from He isotopes at 50 and 200 MeV. DOE

N81-17869# California Univ., Berkeley. Lawrence Berkeley Lab. Nuclear Science Div.

POLARIZATION EFFECTS IN LIGHT NUCLEI

H. E. Conzett Sep. 1980 6 p Presented at the 5th Intern. Symp. on Polarization Phenomena in Nucl. Phys., Santa Fe, N. Mex. 11-15 Aug. 1980
(Contract W-7405-eng-48)
(LBL-11545; CONF-800824-27) Avail: NTIS HC A02/MF A01

Three topics are discussed. Measurement of the deuteron D state is addressed. Experimental and theoretical results for the asymptotic D to S state ratio of the deuteron wave function have converged to about 0.0260. This suggests that P sub D/ = or > 3.5 percent. The discussion on the three nucleon system centered on the present state of agreement between experimental results and results calculated with Faddeev equations. Polarization and analyzing power in the N-15(p,n)O-15 reaction were

considered. Rather large P-A differences were found in the region of 5 to 9 MeV. These differences can be nicely explained by microscopic shell model calculations that include a noncentral nucleon-nucleon interaction and isospin mixing. DOE

N81-17870# Oak Ridge National Lab., Tenn.
PHOTOIONIZATION OF ATOMS AND MOLECULES USING SYNCHROTRON RADIATION
M. O. Krause 1980 5 p refs Presented at 6th Conf. on Appl. of Accelerators in Res. and Ind., Denton, Tex., Nov. 1980 (Contract W-7405-eng-26)
(CONF-801111-19) Avail: NTIS HC A02/MF A01

The potential of synchrotron radiation as a probe of atomic and molecular structure and dynamics is outlined and described by examples taken primarily from photoelectron spectrometric data. DOE

N81-17871# Giessen Univ. (West Germany). Inst. fuer Kernphysik.
DESIGN AND OPTIMIZATION OF A NON-ADIABATIC ZERO-FIELD PASSAGE FOR A SOURCE OF POLARIZED IONS
Eckhardt Althaus Sep. 1980 95 p refs Transl. into ENGLISH from a German source, Jun. 1973
(LA-TR-80-31) Avail: NTIS HC A05/MF A01

A source of polarized protons and deuterons was designed according to Lambshift procedure. In this procedure, protons with the energy of 500 eV and deuterons of 1000 eV are converted into the metastable 2S/sub 1/2/ state through charge exchange reactions in cesium vapor. On the basis of the works of P.G. Sona, an arrangement was constructed, consisting essentially in two solenoids and making possible a double selective quenching of the metastable atoms. Between the first and the second quenching process, a rapid, nonadiabatic direction reversal of the magnetic field occurs, effecting a reallocation of the hyperfine structure states (Sona transition) and thereby increasing the nuclear spin polarization. The quality of a polarized beam can be characterized by the quality measure, this is the product from the beam intensity and the square of polarization (the polarization is included in measurements of asymmetry at the power of 2 due to the error reproduction of the statistical error for particles polarized both by vector and by tensor methods). DOE

N81-17872# Brookhaven National Lab., Upton, N. Y.
CHARM BARYONS: OBSERVED IN BUBBLE CHAMBERS
N. P. Samios 1980 17 p refs Presented at the Baryon 80 Conf., Toronto, 14 Jul. 1980
(BNL-28354) Avail: NTIS HC A02/MF A01

The production and decay of charm baryons as observed in bubble chambers and initiated, as it happens, by neutrinos are reviewed. In particular, the experimental data with respect to the lambda /sub c/(+), sigma /sub c/(++), and sigma sub c/(+) charm baryons are discussed. DOE

N81-17873# Texas Univ., Austin. Center for Particle Theory.
RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY, 1980 Progress Report
E. C. G. Sudarshan and Y. Neeman 1980 89 p
(Contract DE-AS05-76ER-03992)
(DOE/ER-03992/424) Avail: NTIS HC A05/MF A01

Research is reported for these subject areas: particle physics in relativistic astrophysics and cosmology; phenomenology of weak and electromagnetic interactions; strong interaction physics, QCD, and quark-parton physics; quantum field theory, quantum mechanics and fundamental problems; groups, gauges, and grand unified theories: and supergeometry, superalgebra, and unification. DOE

N81-17874# Oxford Univ. (England). Dept. of Engineering Science.
NUMERICAL SOLUTION OF THE BOLTZMANN EQUATION FOR THE ELECTRON DENSITY DISTRIBUTION IN A Hg POSITIVE COLUMN
H. T. Saelee 1979 26 p refs Sponsored by UK Sci. Res. Council
(OUEL-1297/79) Avail: NTIS HC A03/MF A01

A FORTRAN program is provided which solves numerically the Boltzmann equation for the electron energy distribution in electron swarms and gas discharges. Elastic, inelastic, superelastic and Coulomb collisions are taken into account. The solution gives a more exact description of the electron energy distribution in electron swarms and collision dominated partially ionized plasmas. The distribution function of a mercury positive column is calculated for various discharge conditions. The program runs on an ICL 2900 computer. Author (ESA)

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N81-17875# Department of Energy, Las Vegas, Nev.
NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS Quarterly Report, Apr. - Jun. 1980
Aug. 1980 61 p refs
(NVO-196-19) Avail: NTIS HC A04/MF A01

Geologic reconnaissance of the Crater Flat tuff and correlations with existing drill hole data revealed at least three ash-flow tuff members. A topographic base map of the southwest quadrant was compiled. A major effort was devoted to integrating all electrical traverse data obtained near Yucca Mountain with the mapped geology to produce a map of inferred faulting in the area of interest. Precipitation data were analyzed to assess relationships and correlations between the amounts of groundwater recharge from area to area. A simplified computer program and mathematical model were completed in a study of erosion rates in the Great Basin. The In Situ Tuff Water Migration/Heater Experiment was completed and cooldown behavior was monitored; the water generation rates during the experiment were consistent with the values determined previously. DOE

N81-17876# Johns Hopkins Univ., Baltimore, Md.
NUCLEAR MOMENTS AND NUCLEAR STRUCTURE Annual Progress Report, 1 Aug. 1979 - 31 Jul. 1980
Leon Madansky and Yung Keun Lee 1980 82 p refs
(Contract DE-AS02-76ER-03274)
(DOE/ER-03274/1) Avail: NTIS HC A05/MF A01

The results from the relativistic heavy ion central collisions from the Bevatron were updated, and represent the most recent evaluation of an energy scan in a search for phase transitions in nuclear matter. The effective cross section for the pion production and additional information, including the multiplicity distributions and pion-pion correlations, were obtained. Preparation is underway for an approved experiment using heavier projectiles at the Bevalac, searching for the unusual production of high energy gamma rays and lepton pairs as signatures for neutral mesons. The importance of such events as an evidence of the onset phase transition is discussed. An alpha-alpha collision experiment at the CERN ISR in the search for unusual behavior in secondary hadron production is summarized. The measurement of the pionic X-rays using a bent crystal spectrometer is now analyzed to yield the new value for pionic mass, and upper limit for the muonic neutrino mass. Preparation is underway for the approved experiment at the TRIUMF for the study of the neutron and gamma ray correlation in pion capture. DOE

N81-17877# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
LONG-TERM HIGH-LEVEL WASTE TECHNOLOGY Composite Quarterly Technical Report
W. R. Cornman, comp. Oct. 1980 105 p refs
(Contract DE-AC09-78SR-00001)
(DP-80-157-2) Avail: NTIS HC A06/MF A01

Work performed at participating sites to immobilize high-level wastes from the chemical reprocessing of nuclear reactor fuels is summarized. The following aspects are considered: program management and support, waste preparation (retrieval, separation and concentration), waste fixation (in glass, concrete, cermet, tailored ceramics, pellets, metal), process and equipment development, and final handling. DOE

N81-17878# McElroy (Ralph) Co., Austin, Tex.
LEVEL DENSITY AND FISSION PROBABILITY IN SPHERICAL AND DEFORMED NUCLEI
A. V. Ignatyuk, K. K. Istekov, V. N. Okolovich, and G. N. Smirenkin Oct. 1980 33 p refs Transl. into ENGLISH from an Kazakhskoj SSR (USSR), IAEA-SM-241/C9, 1979 33 p Presented at the IAEA Symp. on Phys. and Chem. of Fission, Julich, West Germany, 14-18 May 1979
(LA-tr-80-36; CONF-790507-11-Trans) Avail: NTIS HC A03/MF A01

The important role of rotational increase in the level density of nuclei is demonstrated in a description of the observed fission probability of subactinide nuclei. From an analysis of the experimental data available, energy dependence for the corresponding coefficient is found that exhibits deviations from the adiabatic estimate of rotational effects in highly excited nuclei. By allowing for collective effects in fission and neutron decay channels of compound nuclei, it is possible to obtain a consistent description of the fissionability observed both in the near threshold region and in the high energy region, where fission by means of emission is dominant. The dependence of fission barriers on mass number, as determined from an analysis of the fissionability of subactinide nuclei, differs considerably from what was found in previous work. DOE

N81-17879# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
WASTE MANAGEMENT PROGRAM Quarterly Technical Progress Report, Jan. - Mar. 1980
Sep. 1980 77 p refs
(Contract DE-AC08-70SR-00001)
(DP-80-125-1) Avail: NTIS HC A05/MF A01

Current information on operations and development programs for the management of radioactive wastes from operation of the Savannah River Plant are reported. Process and equipment development studies are considered as well as surveillance and maintenance, waste concentration, low level effluent waste, waste tank evaluation, and tank replacement/waste transfer (formerly waste tank retirement). Criteria for the selection of sites for storage of waste forms produced in the Defense Waste Processing Facility are described. A.R.H.

N81-17880# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
SIGNIFICANCE OF RADIATION EFFECTS IN SOLID RADIOACTIVE WASTE
Philip H. Permar and William R. McDonnell 1980 55 p refs Presented at 10th Symp. on Effects of Radiation on Mater. Submitted for publication
(Contract DE-AC09-76SR-00001)
(DP-MS-80-27; CONF-800609-5) Avail: NTIS HC A04/MF A01

Candidate waste forms beside the spent fuel elements themselves, include borosilicate and related glasses, mineral-like crystalline ceramics, concrete formulations and metal-matrix glass or ceramic composites. These waste forms will sustain damage produced by beta-gamma radiation up to 10 to the 12th power rads, by alpha radiation up to 10 to the 19th power particles/g, by internal helium generation greater than about 0.1 atom percent, and by the atom transmutations accompanying radioactive decay. Data indicates that under these conditions the glass forms suffer only minor volume changes, stored energy deposition, and leachability effects. The crystalline ceramics appear susceptible to the potentially more severe alterations accompanying metamictization. Helium concentrations in the waste forms are generally below thresholds for severe damage in either glass or crystalline ceramics at low temperature, but microstructural effects are not well characterized. T.M.

N81-17881# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Advanced Planning Section.
HIGH-LEVEL NUCLEAR WASTE IMMOBILIZATION PROGRAM
D. E. Gordon 1980 18 p refs Presented at ANS Meeting, Atlanta, 3-8 Jun. 1979 Sponsored by DOE
(DP-MS-80-25; CONF-800244-1) Avail: NTIS HC A02/MF A01

Existing high level nuclear wastes in the United States are described along with current management techniques and long term disposal options. All of the disposal options involve some type of immobilization operation to restrict radionuclide dispersion; the primary option is disposal of immobilized waste packages in deep (500-1000 meter) geological formations. Several immobilized waste forms currently under development are discussed, and form selection factors and regulatory criteria are identified.
Author

N81-17882# Oak Ridge National Lab., Tenn.
PHENOMENOLOGICAL MODEL FOR PARTICLE PRODUCTION FROM THE COLLISION OF NUCLEONS AT MEDIUM ENERGIES WITH FISSILE ELEMENTS
F. S. Alsmiller, R. G. Alsmiller, Jr., T. A. Gariel, R. A. Little, and J. Barish 1980 9 p refs Presented at the ANS Intern. Conf., Washington, D.C., 17 Nov. 1980
(Contract W-7405-eng-26)
(CONF-801107-43) Avail: NTIS HC A02/MF A01

The addition of a detailed fission channel, including fragment mass, charge kinetic energy, and excitation energy distributions, to the evaporation stage of the Monte Carlo code MECC-7 for nuclear cross sections and particle production is reported. In this code the intranuclear-cascade-evaporation model is applied to nucleon and pion nonelastic reactions at energies between 20 MeV and 3 GeV. The revisions to the model are discussed. Calculated fission-neutron multiplicities are tabulated for U 235, U 238, and Pu239. DOE

N81-17883# Sandia Labs., Albuquerque, N. Mex.
DRIVERS FOR LIGHT ION FUSION
J. P. VanDenvender 1980 12 p refs Presented at the 4th ANS Topical Meeting on the Technol. of Controlled Fusion, King of Prussia, Pa., 14-17 Oct. 1980
(Contract DE-AC04-76DP-00789)
(SAND-80-2432C; CONF-801011-20) Avail: NTIS HC A02/MF A01

The light ion approach to inertial confinement fusion requires the production of 10 to the 13th power to 10 to the 14th power watt and 10 to the 6th power to 10 to the 7th power joule pulses. The accelerator technology developed in the particle beam fusion program is capable of fulfilling these requirements. DOE

N81-17884# Sandia Labs., Albuquerque, N. Mex.
STATUS OF SUBSEABED REPOSITORY DESIGN CONCEPTS AND RADIONUCLIDE
L. H. Brush 1980 12 p refs Presented at the 2nd Ann. Natl. Waste Terminal Storage (NWTS) Inform. Meeting, Columbus, Ohio, 9 Dec. 1980
(SAND-80-2456C; CONF-801209-6) Avail: NTIS HC A02/MF A01

Various projects in support of the marine disposal of radioactive wastes are described. These include: geochemical studies on sediments; canister related research and development activities; radionuclide transport studies through smectitic sediments; seawater sediment interactions under near field conditions; effects of a radiation field on high temperature, seawater sediment interactions; sorption of fission products and actinides by deep sea sediments under far field (below 100 C) conditions; sorption experiments using column diffusion; development of a computer code, IONMIG, to model the migration of radionuclides through undisturbed deep sea sediments; and planning for a field test of the laboratory measurements and computer models of radionuclide transport. DOE

N81-17885# Battelle Pacific Northwest Labs., Richland, Wash. Nuclear Waste Technology Program.
NUCLEAR WASTE MANAGEMENT Quarterly Progress Report, Apr. - Jun. 1980
A. M. Platt and J. A. Powell, comp. Sep. 1980 153 p refs
(Contract DE-AC06-76RL-01830)
(PNL-3000-6) Avail: NTIS HC A08/MF A01

The status of the following programs is reported: high-level waste immobilization; alternative waste forms; nuclear waste materials characterization; TRU waste immobilization; TRU waste decontamination; krypton solidification; thermal outgassing; iodine-129 fixation; monitoring and physical characterization of unsaturated zone transport; well-logging instrumentation development; mobility of organic complexes of fission products in soils; waste management system studies; waste management safety

studies; assessment of effectiveness of geologic isolation systems; waste/rock interactions technology; systems study on engineered barriers; criteria for defining waste isolation; spent fuel and fuel pool component integrity program; analysis of spent fuel policy implementation; asphalt emulsion sealing of uranium tailings; application of long-term chemical biobarriers for uranium tailings; and development of backfill material. DOE

74 OPTICS

Includes light phenomena.

N81-17886* National Aeronautics and Space Administration. Pasadena Office, Calif.

SYSTEM FOR FORMING A QUADRIFIED IMAGE COMPRISING ANGULARLY RELATED FIELDS OF VIEW OF A THREE DIMENSIONAL OBJECT Patent

Frederick R. Chamberlain, inventor (to NASA) (JPL) Issued 22 Jul. 1980 6 p Filed 20 Mar. 1978 Supersedes N78-22348 (16 - 13, p 1701) Sponsored by NASA

(NASA-Case-NPO-14219-1; US-Patent-4,213,684; US-Patent-Appl-SN-888432; US-Patent-Class-354-118; US-Patent-Class-350-301; US-Patent-Class-362-11; US-Patent-Class-362-241) Avail: US Patent and Trademark Office CSCL 20F

A system for generating, within a single frame of photographic film, a quadrified image including images of angularly (including orthogonally) related fields of view of a near field three dimensional object is described. It is characterized by three subsystems each of which includes a plurality of reflective surfaces for imaging a different field of view of the object at a different quadrant of the quadrified image. All of the subsystems have identical path lengths to the object photographed.

Official Gazette of the U.S. Patent and Trademark Office

N81-17887* National Aeronautics and Space Administration. Pasadena Office, Calif.

DOUBLE-BEAM OPTICAL METHOD AND APPARATUS FOR MEASURING THERMAL DIFFUSIVITY AND OTHER MOLECULAR DYNAMIC PROCESSES IN UTILIZING THE TRANSIENT THERMAL LENS EFFECT Patent

Jovan Moacanin (JPL), Amitava Gupta (JPL), and Su-don Hong, inventors (to NASA) (JPL) Issued 6 Jan. 1981 11 p Filed 31 Jan. 1979 Supersedes N79-17683 (17-08, p 1052)

(NASA-Case-NPO-14657-1; US-Patent-4,243,327; US-Patent-Appl-SN-008211; US-Patent-Class-356-432; US-Patent-Class-73-15R) Avail: US Patent and Trademark Office CSCL 20F

A sample material was irradiated by relatively high power, short pulses from a dye laser. Energy from the pulses was absorbed by the sample material, thereby forming a thermal lens in the area of absorption. The pulse repetition rate was chosen so that the thermal lens is substantially dissipated by the time the next pulse reaches the sample material. A probe light beam, which in a specific embodiment is a relatively low power, continuous wave (cw) laser beam, irradiated the thermal lens formed in the sample material. The intensity characteristics of the probe light beam subsequent to irradiation of the thermal lens is related to changes in the refractive index of the sample material as the thermal lens is formed and dissipated.

Official Gazette of the U.S. Patent and Trademark Office

N81-17888* National Aeronautics and Space Administration. Pasadena Office, Calif.

INTERFEROMETER Patent

James B. Breckinridge, inventor (to NASA) (JPL) Issued 6 Jan. 1981 6 p Filed 30 Nov. 1978 Supersedes N79-19317 (17-10, p 1279) Sponsored by NASA

(NASA-Case-NPO-14502-1; US-Patent-4,243,323; US-Patent-Appl-SN-965368; US-Patent-Class-356-345; US-Patent-Class-356-352; US-Patent-Class-356-358) Avail: US Patent and Trademark Office CSCL 20F

An interferometer of relatively simple design which is tilt compensated, and which facilitates adjustment of the path lengths of split light beams is described. The interferometer includes a pair of plate-like elements with a dielectric coating and an oil film between them, that forms a beamsplitter interface, and with a pair of reflector surfaces at the ends of the plates. A pair of retroreflectors are positioned so that each split beam component is directed by a retroreflector onto one of the reflector surfaces and is then returned to the beamsplitter interface, so that the reflector surfaces tilt in a direction and amount that compensates for tilting of the beamsplitter interface.

Official Gazette of the U.S. Patent and Trademark Office

N81-17889# Air Force Weapons Lab., Kirtland AFB, N. Mex. Applied Physics Div.

FIBER OPTIC TRANSMITTER AND RECEIVER RADIATION EVALUATION Final Report

Bernd Deve and Keith Loree Sep. 1980 97 p Sponsored by the Defense Nuclear Agency

(AD-A092959; AFWL-TR-79-168) Avail: NTIS HC A05/MF A01 CSCL 20/6

This report describes the radiation characterization of fiber optic transmitter and receiver integrated circuits developed by the Air Force Avionics Laboratory. These devices were manufactured by Spectronics of Honeywell and the model numbers are SPX 3619, SPX 3620, SPX 4125 and SPX 4126. Nuclear radiation hardness was not a specific goal in the development of these integrated circuits. The devices were evaluated for catastrophic failure and performance degradation in a neutron and total gamma dose environments. Possible latch-up and transient upset were evaluated in an ionizing dose rate environment. GRA

N81-17890# Howard Univ., Washington, D. C. Dept. of Chemistry.

RAMAN INVESTIGATION OF OPTICAL FIBERS UNDER HIGH TENSILE STRESS

G. E. Walrafren, P. N. Krishnan, and S. W. Freiman 25 Nov. 1980 33 p refs Presented at the 82nd Ann. Meeting of the ACS, Chicago, 29 Apr. 1980 Prepared in cooperation with Coppin State Coll., Baltimore, Md. and NBS, Gaithersburg, Md. (Contract N00014-80-C-0305)

(AD-A093089; TR-1) Avail: NTIS HC A03/MF A01 CSCL 07/4

Raman spectra have been obtained from fused silica optical fibers under tensile stresses from 0 to 3.3 GPa (33 kbar). Reversible intensity increases, relative to the principal Raman maximum at 490 per cubic meter were observed for the defect peak at 490 per cubic meter and for shoulders near 350-375 per cubic meter and 115 per cubic meter. Application of tensile stress to fused silica appears to produce changes in the stretched Si-O defect sites, as well as changes in the main network structure. GRA

N81-17891# Oak Ridge National Lab., Tenn.

STUDIES OF THE INTERACTIONS OF IONIZING RADIATIONS WITH COMMUNICATIONS MATERIALS Interim Report, 1 Oct. 1978 - 30 Sep. 1980

M. W. Williams and J. C. Ashley Griffiss AFB, N.Y. RADC Nov. 1980 64 p refs

(AF Proj. 2306)

(AD-A093106; RADC-TR-80-348) Avail: NTIS HC A04/MF A01 CSCL 20/6

This report summarizes experimental and theoretical studies designed to yield information on the interaction of ionizing radiations with various communications materials. The optical properties of Kapton have been measured over the energy range from 0.5 eV to 76 eV. Theoretical models combined with experimental optical data have been used to calculate mean excitation energies, mean free paths, and stopping powers for low-energy electrons (100 eV to 10 keV) in various solid organic insulators. The contribution to both the mean free path and stopping power due to K-shell ionizations in carbon, nitrogen, and oxygen where then obtained from theoretical atomic generalized oscillator strengths and added to the valence electron contributions. A model involving the diffusion of excitons has been proposed to explain data, reported in the literature, showing that a thin metallic surface layer may partially protect organic crystals against radiation damage. The stopping powers of several metals for electrons have been calculated from an electron gas statistical model and used to calculate the continuous slowing-down-approximation range and range straggling for electrons with energies + or = 10 keV. Microdosimetric calculations have been made of the structure of heavy-ion

tracks in silicon. Results show that these tracks are very small in lateral extent compared with the dimensions of critical volumes in currently used microelectronic components. GRA

N81-17892# Hughes Research Labs., Malibu, Calif.
LOW-LOSS INFRARED FIBERS Final Report, 1 Aug. 1979 - 26 Sep. 1980
James A. Harrington Dec. 1980 62 p refs
(Contract N00173-79-C-0348)
(AD-A093151) Avail: NTIS HC A04/MF A01 CSCL 20/6

This final report describes research on low-loss fiber waveguides for use in future long-distance fiber links. The goal of the program is to develop non-oxide-containing fibers with losses as low as 10 to the minus 3rd power dB/km. This work is part of an overall technology assessment to determine the feasibility of fabricating such ultra low loss optical fibers. The approach being used to develop these very transparent waveguides is to fabricate fiber from IR transmitting crystalline materials. The materials studied were the alkali and thallium halides. We found that we could not successfully apply our extrusion technology, developed for the thallium halides, to fabricate alkali halide fibers. Extruded KCl or CsI fibers, for example, always had poor surface quality due to surface cracks (fish-scale appearance). We therefore abandoned extrusion methods for the alkali halides in favor of other fiber fabrication techniques. An alternative technique used was single crystal (SC) fiber growth. SC fibers represent a potentially ideal waveguide because they are free from mechanical defects (such as strain fields associated with grain boundaries in extruded polycrystalline fibers) and thus should have less scattering losses than polycrystalline waveguides. To make SC fibers we used an inverted Czochralski growth technique and applied the method to KC1. By the end of the program we had not yet produced any SC KCl fiber, but we expect to do so shortly. GRA

N81-17893# Gulf and Western Applied Science Labs., Waltham, Mass.
THE MOISTURE PROTECTION OF STRONG OPTICAL FIBERS Interim Report, Sep. 1978 - Mar. 1980
S. Aisenberg and M. Stein Griffiss AFB, N.Y. RADC Nov. 1980 51 p refs Prepared in cooperation with Galileo Electro-Optics Corp., Sturbridge, Mass.
(Contract F19628-78-C-0180; ARPA Order 3282)
(AD-A093134; ASL-TI-977; RADC-TR-80-252) Avail: NTIS HC A04/MF A01 CSCL 11/3

This program addresses the military and commercial needs for strong optical fibers having a high degree of durability. The approach to solving this problem is to demonstrate the feasibility of producing hermetically coated fibers, coating with a suitable hermetic barrier, proof testing, optical and mechanical characterization, and analysis of results. The hermetic coating system has been designed to coat fibers which have previously been drawn. Materials evaluated as hermetic coatings included ion deposited carbon, tin, and indium. Initial results indicate that the ion deposited forms of carbon and indium alone or in combination appear to provide the best compromise of coating properties, while not degrading fiber strength. The long range objective of this program is to produce fibers with 1-7 db per kilometer attenuation at 850 nanometers, proof tested in excess of 100,000 psi, in lengths of 10-30 kilometers. It is anticipated that after hermetic coating, these optical waveguides will exhibit a 95% probability of survival in moist environments when subjected to a 2% continuous strain over periods up to 10 years. GRA

N81-17894# EMTEC Engineering, Inc., Los Angeles, Calif.
THEORETICAL ANALYSIS OF MULTIMODE FIBER STRUCTURES Final Technical Report, Jan. - Aug. 1980
C. Yeh Griffiss AFB, N. Y. RADC Oct. 1980 103 p refs
(Contract F19628-80-C-0053; AF Proj. 2306)
(AD-A093142; EM-F-02; RADC-TR-80-332) Avail: NTIS HC A06/MF A01 CSCL 20/6

This study examined propagation characteristics of a light beam in multimode fiber structures. Realistic fiber structures made with commercially available fibers such as those provided by Corning or ITT were studied. The resultant computer programs may be used readily to generate design data for structures made with realistic fibers with step or parabolic index profiles. It is believed that our unique approach based on the scalar-wave FFT method may be extended to treat problems dealing with nonlinear fibers or fibers with frozen-in statistically varying index profiles. GRA

N81-17895# Utah Univ., Salt Lake City. Geospace Sciences Lab.
GEOPHYSICAL FIBER INTERFEROMETER GYROSCOPE Final Report, 27 Sep. 1978 - Sep. 1979
Lawrence D. Weaver 31 Dec. 1979 81 p refs
(Contract F19628-78-C-0236; AF Proj. 7600)
(AD-A092913; GSL-79-013; AFGL-TR-79-0286) Avail: NTIS HC A05/MF A01 CSCL 20/6

This report describes a development effort of the University of Utah Research Institute aimed at perfecting a North-seeking device based on the passive interferometer gyroscope concept. The rotation sensing mechanism of the interferometer is based on the Sagnac effect. The form of the interferometer is a fiber ring. The performance requirements of the device are developed in terms of desired pointing accuracy vs. measurement resolution or sensitivity. The interferometer performance will be compared to that of a typical ring-laser gyro. Methods by which the sensitivity of the interferometer could be potentially increased will be discussed. Two of these methods, namely the electro-optic phase shifter and acousto-optic frequency shifter, were evaluated and their limitations regarding the performance of a fiber interferometer gyroscope will be addressed. Additionally, signal processing requirements will also be discussed. Finally, the theoretical limit for performance of a fiber-optic interferometer will be discussed in terms of the so-called 'photon noise limit.' This is the limit to performance that several researchers have alluded to in arriving at the ultimate sensitivity of a passive interferometer laser gyroscope. Suggestions for a device in which the photon noise limit may be approached will also be discussed. GRA

N81-17896# California Univ., Los Angeles.
TRIBOLUMINESCENCE Final Report, 10 Aug. 1977 - 30 Sep. 1980
William C. Kaska and Jeffrey I. Zink Dec. 1980 28 p refs
(Grant DAAG29-77-G-0195)
(AD-A093805; ARO-14971.6-C) Avail: NTIS HC A03/MF A01 CSCL 20/6

Triboluminescence is the emission of light caused by the application of mechanical energy to solids. Although the phenomenon has been known since the 17th century, neither the excited state origins of the luminescence nor the mechanism by which it is excited were understood until recently. Our efforts have focussed on the fundamental requirements for triboluminescence. We have uncovered and studied the fracture requirement, the pressure requirement, and the structure requirement for triboluminescence activity. We have also derived a quantitative theory for the dynamics of triboluminescence based on the dynamics of the creation and interaction of mobile fractures in a crystal. In addition to explaining the time dependence of the luminescence, the theory treats the effects of size and impact velocity on the luminescence intensity. The instrument--which was designed to measure these effects--also enabled us to quantitively compare the relative intensities of various crystals. We have continued to study triboluminescence spectroscopy. High pressure spectroscopy has played an important role in investigating the pressure requirements for triboluminescence. Finally, the synthesis and chemistry of triboluminescent materials, which have continued to be a cornerstone in the above investigations, led to the discovery of the polymorphic hexaphenylcarbodiphosphorane crystals and to other interesting materials which are described. GRA

N81-17897# Honeywell Systems and Research Center, Minneapolis, Minn.
ADVANCED TARGET TRACKER CONCEPTS Quarterly Progress Report, 29 Dec. 1979 - 30 Mar. 1980
P. M. Narendra and B. L. Westover Apr. 1980 90 p refs
(Contract DAAK10-79-C-0150)
(AD-A094008; HONEYWELL-80SRC47; QPR-2) Avail: NTIS HC A05/MF A01 CSCL 17/8

Conventional target tracking approaches rely on numerical correlation over successive frames on a window around the target. They are therefore sensitive to partial obscuration and changes in target and background appearances. Furthermore, multiple-

target tracking requires replication of the hardware. In this report, we present the development of a multiple-target tracking approach based on a dynamic scene model derived from the analysis of a time sequence of imagery. Simulation results demonstrate multiple-target tracking in cluttered backgrounds and in imagery from fast-moving platforms. The approach can be implemented as an integral part of the Honeywell target screener system. GRA

N81-17898# Stanford Univ., Calif. Physics Lab.
TUNABLE OPTICAL SOURCES Final Report, 1 Sep. 1979 - 31 Aug. 1980
Robert L. Byer Nov. 1980 85 p refs
(Contract DAAG29-79-C-0181)
(AD-A093688; SU-GL-3209; ARO-15278.11-P) Avail: NTIS HC A05/MF A01 CSCL 20/5

We have successfully completed the study, development and application of a computer controlled Nd:YAG pumped LiNbO3 tunable source. The device has operated reliably for more than one year. It tunes over a 1.4 - 4.0 micron range and operates at resolutions to less than 0.08 per cm at 10 mJ output at 10 pps. We have invented and demonstrated a new optical device, the radial birefringent element. We have invented and demonstrated a computer controlled laser attenuator. During the past year we have developed the theory for a slab configuration laser source. We have successfully demonstrated the slab geometry as applied to Nd:Glass. Work is continuing on the understanding and implementation of this high energy, high repetitional rate Nd:Glass slab laser source. GRA

N81-17899# Mitre Corp., Bedford, Mass.
ELECTRONIC CIRCUITS AND OPTICAL SOURCES FOR FIBER OPTIC SYSTEMS Interim Report
G. L. Tenuta Nov. 1980 23 p
(Contract F19628-80-C-0001; AF Proj. 4519)
(AD-A093511; RADC-TR-80-310) Avail: NTIS HC A02/MF A01 CSCL 09/1

This document is one in a series of technical reports on the subject of fiber optic systems design. This report covers the electronic circuits and optical components needed to design high-performance laser and LED (light emitting diode) transmitters for optical communications. Subsequent reports in this series will cover the design of low-noise, high-sensitivity preamplifiers, including related hardware such as AGC (automatic gain control) and FM receivers. Applications involving a bidirectional link and video transmitter and receiver are also described, as well as architectures and concepts for development of complete systems. GRA

N81-17900# Army Electronics Research and Development Command, White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
INITIAL FIELD MEASUREMENTS OF ATMOSPHERIC ABSORPTION AT 9 MICROMETERS TO 11 MICROMETERS WAVELENGTHS Final Report
Charles W. Bruce, Young Paul Yee, B. D. Hinds, R. G. Pinnick, and Ralph J. Brewer Oct. 1980 34 p refs
(DA Proj. 1L1-61102-B-53A)
(AD-A093709; ERADCOM/ASL-TR-0068) Avail: NTIS HC A03/MF A01 CSCL 04/1

A field-adapted spectrophone system employing a tunable CO2 laser source (over wavelengths 9.2 micrometers to 10.8 micrometers, was used to measure atmospheric gaseous and particulate absorption at an isolated desert southwestern location in the United States. Measurements were made both for ambient conditions (when aerosol particulate absorption was negligible compared to that of gases) and for dusty conditions resulting from vehicular traffic. For ambient conditions, the gaseous absorption coefficient varied with time from expected levels upward by as much as a factor of 3. Sources which could be correlated with increased absorption are discussed. For dusty conditions the spectrophone data were compared with estimates of the absorption coefficient calculated on the basis of measured particle size distributions together with estimates of particle complex indices of refraction. Temporal variation of the absorption coefficient correlated closely for the two methods, while the calculated values were generally higher. Sampling and calculational uncertainties are suggested as likely to be responsible for this discrepancy. GRA

N81-17901# Atmospheric and Environmental Research, Inc., Cambridge, Mass.
INVESTIGATION OF THE EFFECT OF LOW LEVEL MARITIME HAZE ON DMSP VHR AND LF IMAGERY Final Report, 1 Apr. - 30 Sep. 1980
Ronald G. Isaacs 9 Sep. 1980 128 p refs
(Contract N00014-80-C-0262)
(AD-A093466) Avail: NTIS HC A07/MF A01 CSCL 17/8

An efficient modeling approach is described to simulate the dependence of remotely sensed radiances at visible and near infrared wavelengths (04.-1.1 micrometers) on meteorological variables such as relative humidity, wind speed, and visual range. Model elements include: (1) atmospheric opacity due to Rayleigh scattering and gaseous absorption; (2) physical modeling of aerosol size distribution; (3) aerosol optical properties calculations; and (4) implementation of radiative transfer theory. Sensitivity analyses are performed for these variables in the context of examining modeled meteorological influences in the marine environment on the DMSP VHR and LF sensors. The sensitivity of emergent radiances in the near infrared spectral windows to the presence of relative humidity and wind speed dependent coarse mode aerosols of oceanic origin is demonstrated. GRA

N81-17902# Boeing Aerospace Co., Seattle, Wash.
AIRBORNE-FIBER OPTICS MANUFACTURING TECHNOLOGY, AIRCRAFT INSTALLATION PROCESSES Final Report, May 1978 - Jun. 1980
G. Kosmos and R. A. Greenwell San Diego, Calif. Naval Ocean Systems Center 19 Aug. 1980 348 p refs
(Contract N00123-78-C-0193)
(AD-A093304; NOSC/TR-591) Avail: NTIS HC A15/MF A01 CSCL 20/6

Manufacturing processes were developed for installation of optical fiber harnesses and 'stand alone' links on military aircraft. Fabrication and installation plans and procedures were developed and a routing analysis was performed to provide a basis for installation of fiber optics in military aircraft. A life cycle cost analysis of the optical fiber harness indicates economic advantages. GRA

N81-17903# Bendix Corp., Kansas City, Mo.
NORMALIZATION OF THE SCATTERED LIGHT FROM AN ISOLATED DEFECT ILLUMINATED BY A GAUSSIAN BEAM
P. E. Klingsporn Jul. 1980 33 p refs
(Contract DE-AC04-76DP-00613)
(BDX-613-2391) Avail: NTIS HC A03/MF A01

A method of normalization is described which makes direct use of the Gaussian intensity distribution of the transverse electromagnetic field. The amount of light scattered by a defect is normalized to the value which would be observed if the defect were located at the center of the beam, for a defect small in size compared with the 1/e squared diameter of the Gaussian profile. The normalization requires that three measurements be made of the scattering by the defect for an arbitrary location of the defect relative to the center of the Gaussian beam, and that the 1/e squared radius of the Gaussian beam and the interval between adjacent illuminated spots on the surface are known. Data verifying the theory are shown from isolated defects on a superfinished spherical surface. DOE

N81-17904# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
OPTICAL PARAMETRIC OSCILLATOR FOR GENERATING ADJUSTABLE, COHERENT INFRARED RADIATION [OPTISCHER PARAMETRISCHER OSZILLATOR ZUR ERZEUGUNG ABSTIMMBARER KOHAERENTER INFRAROSTRAHLUNG]
K. J. Schmatjko and J. Wolfrum Sep. 1979 36 p refs In GERMAN
(MPIS-18/1979; ISSN-0436-1199) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8.40

The construction and characteristics of an optical parametric LiNbO3 crystal oscillator are described. Application in an

adjustable infrared laser is shown. Laser pumping is discussed in terms of the laser resonator, wavelength and mode selection. The principle of an optical parametric oscillator is defined and pumped light coupling was studied. The characteristics of the infrared radiation emitted by an optical parametric oscillator are reported. Various experiments using an adjustable infrared laser for chemical analysis through dye laser absorption spectroscopy are outlined. . Author (ESA)

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N81-17905# Nagoya Univ. (Japan).

QUASI-STATIC COMPRESSIONAL HEATING OF A TOKAMAK

Kei-ichi Hirano Dec. 1980 43 p refs

(IPPJ-495) Avail: NTIS HC A03/MF A01

It was demonstrated that nonadiabatic compressional heating process can be described by a physical picture which assumes that the process is composed of a long chain of an infinitesimally small unit event made up by successive adiabatic compression and diffusive expansion of a plasma. Based on that picture, a fundamental compressional heating equation applicable to both B sub t and R compression was obtained. As a result, the additional heating effect observed in Tuman was found to be predicted. The equation becomes a linear differential equation of the first order if high power neutral beam heating and the energy confinement time of Alcator scaling type are assumed. T.M.

N81-17906# Nagoya Univ. (Japan). Inst. of Plasma Physics.

SIMULATION OF ADIABATIC COMPRESSION PLASMA

Rui-yan Lin, Kei-ichi Hirano (Acedemia Sinica, Peking), and Masao Okamoto Nov. 1980 30 p refs

(IPPJ-494) Avail: NTIS HC A03/MF A01

A system of one-dimensional transport codes for studying the discharge processes of compressional Tokamak plasma in the Tuman-2, Tosca, and STP-3 devices is described. The code includes the effects of neutrals and impurity radiation. The model provides reasonably good fits of the main data from the experiments of Tosca and Tuman-2. The computational predictions for the STP-3 device are also presented. The computed results show that the average ion temperature of the STP-3 discharge with compression is about twice the value without compression. The higher the Ohmic heating power, the slower the optimum compression time becomes. M.G.

N81-17907# Maryland Univ., College Park. Dept. of Physics and Astronomy.

COLLISIONAL DRIFT WAVES IN A PLASMA WITH ELECTRON TEMPERATURE INHOMOGENEITY

J. F. Drake and A. B. Hassam 1 Sep. 1980 34 p refs

(Contract DE-AC05-79ET-53044)

(AD-A093639; PUB-81-058; PL-81-008) Avail: NTIS HC A03/MF A01 CSCL 20/9

A fluid theory of collisional electrostatic drift waves in a plasma slab with magnetic shear is presented. Both electron temperature and density gradients are included. The equations are solved analytically in all relevant regions of the parameter space defined by the magnetic shear strength and the perpendicular wavelength and explicit expressions for the growth rates are given. For shear strengths appropriate for present-day Tokamak discharges the temperature gradient produces potential wells which localize the mode in the electron resistive region, well inside the ion sound turning points. Mode stability arises from a competition between the destabilizing influence of the time dependent thermal force and the stabilizing influence of electron energy dissipation. Convective energy loss is not important for shear parameters of present-day fusion devices. GRA

N81-17908# California Univ., Berkeley. Electronics Research Lab.

PLASMA THEORY AND SIMULATION Quarterly Progress Report, 1 Apr. - 30 Jun. 1980

Charles K. Birdsall 30 Jun. 1980 58 p refs

(Contracts N00014-77-C-0578; DE-AS03-76SF-00034)

(AD-A093381; QPR-2) Avail: NTIS HC A04/MF A01 CSCL 20/9

The study of the lower-hybrid drift instability has been expanded from one dimensional simulation using a hybrid ES1 code two dimensional simulation which allows us to study the nonlocal effects and the diffusion phenomena using the EZOHAR code. Similar to the one dimensional simulation, a slab shape is assumed and the equilibria are functions of x only. The drift velocity is in the y direction and the magnetic field is in the z direction. The simulations are carried out in the x-y plane. In our previous one dimensional simulations, ions were treated as fully nonlinear particles and electrons only appeared in a linear electron susceptibility. Now both ions and electrons are fully nonlinear particles; therefore, all the electron nonlinearities can be studied. We still restrict our simulation to a zero-beta plasma. GRA

N81-17909# General Atomic Co., San Diego, Calif.

FIRST WALL ENGINEERING AND TECHNOLOGY IN FUSION

G. R. Hopkins Sep. 1980 15 p refs Presented at 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14 Oct. 1980

(Contract DE-AT03-76ET-51011)

(GA-A-16089) Avail: NTIS HC A02/MF A01

The reactor plasma environment is analyzed with reference to its interaction with the first wall. It is stated that the energy partition between the radiation and particle loads has a high uncertainty at this state of development and it would be desirable to control this for fusion power reactors. Plasma disruptions cause high pulsed heat loads, with magnitudes sufficient to melt and vaporize refractory materials. With the worst projections, first wall lifetimes would be unduly short in power reactors. With continuing attention to the disruption phenomenon, however, the experience gained in experimental power devices should provide the background for plasma boundary region control to prevent surface erosion, and to limit the number and intensity of plasma disruptions. DOE

N81-17910# Los Alamos Scientific Lab., N. Mex.

POSSIBLE APPLICATION OF ELECTROMAGNETIC GUNS TO IMPACT FUSION

R. N. Kostoff (DOE), F. L. Ribe (Washington Univ.), and A. T. Peaslee 1980 9 p refs Presented at the Electromagnetic Guns and Launchers Conf., San Diego, Calif., 4-6 Nov. 1980

(Contract W-7405-eng-36)

(LA-UR-80-3137; CONF-801138-4) Avail: NTIS HC A02/MF A01

The concept of impact fusion is discussed in terms of application to generation of electric power. Target interactions and acceleration systems are addressed. The potential of the rail gun as an impact fusion macroparticle accelerator is assessed including the relative advantages of the rail gun. J.M.S.

N81-17911# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

ENVIRONMENTAL AND SAFETY ISSUES OF THE FUSION FUEL CYCLE

J. G. Crocker 1980 13 p refs Presented at the 4th ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, King of Prussia, Pa., 14 Oct. 1980

(Contract DE-AC07-76ID-01570)

(CONF-801011-66) Avail: NTIS HC A02/MF A01

The environmental and safety concerns inherent in the development of fusion energy are discussed. Specific topics covered include: (1) safe and reliable techniques for tritium control; (2) reduce the quantity of activation products produced; and (3) provide designs to limit the potential for accidents that could result in release of radioactive materials. Because of the inherent safety features of fusion and the early start that has been made in safety problem recognition and solution, fusion should be among the lower risk technologies for generation of commercial power. DOE

N81-17912# California Univ., Livermore. Lawrence Livermore Lab.

USE OF RADIATIVE LINE BROADENING BY AN INTENSE LASER FIELD AS A PLASMA DIAGNOSTIC

L. Schlessinger and J. Wright Aug. 1980 17 p refs

(Contract W-7405-eng-48)

(UCRL-15294) Avail: NTIS HC A02/MF A01

In many laser fusion applications it would be of significant interest to have an independent measurement of the strength of the laser electric field at various positions in the plasma. In many cases of interest, the line broadening caused by an intense laser field can provide such a measurement. For low-Z elements at moderate temperatures and for typical laser intensities and densities, the line broadening caused by the intense field is the dominant source of line width. In this situation the line width depends on the strength of the laser field at that position and the line profile is quite unique, having a characteristic and calculable dependence on the angle between the laser electric field and the direction of the radiated photon. These special properties should allow the lines of low-Z elements seeded at various positions in the plasma to be identified, their widths determined, and the value of the laser electric field at that position derived. DOE

N81-17913# Brookhaven National Lab., Upton, N. Y.

DESIGN OF LONG PULSE/STEADY STATE NEGATIVE HYDROGEN ION SOURCES FOR FUSION APPLICATIONS

K. Prelec 1980 4 p refs Presented at the 6th Conf. on Appl. of Accelerators in Res. and Ind., Denton, Tex., 3-5 Nov. 1980

(Contract DE-AC02-76CH-00016)

(BNL-28561; CONF-401111-23) Avail: NTIS HC A02/MF A01

A penning source was designed for a steady state operation with a cathode power density of 1 kW/sq cm. For the range of cathode power densities between 0.2 kW/sq cm and 1 Kw/sq cm, nucleated boiling has to be used for heat removal; below 0.2 kW/sq cm water flow cooling suffices. Although this source should deliver 0.3 to 0.5 A of H(-) ions in a steady state operation and at full power, another source, which has a magnetron geometry, is more promising. The latter incorporates geometrical focusing of fast, primary negative hydrogen ions from the cathode into the extraction slit, and a wider discharge gap in the back of the source. These two changes resulted in an improvement of the power and gas efficiencies by a factor of 3 to 4 and in a reduction of the cathode power density by an order of magnitude. The source has water cooling for all the electrodes, because maximum power densities will not be higher than 0.2 kW/sq cm. Author

N81-17914# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

FAR INFRARED POLARIMETRY FOR POLOIDAL FIELD DETERMINATION IN TOKAMAK PLASMA

Wolfgang Kunz 1979 107 p refs In GERMAN; ENGLISH summary

(IPF-79-1) Avail: NTIS HC A06/MF A01

The poloidal magnetic field distribution in a Tokamak plasma, determined on the basis of the Faraday effect, was investigated numerically and experimentally. Calculations based on appropriate plasma models, on the Appleton-Martree formula for the refractive index, and on the Poincare representation of the state of polarization yield optimum measurement wavelengths for actual Tokamak plasmas in the range 200 to 400 microns. Numerical simulations show the feasibility of the technique in terms of the experimental precision with which the Faraday profile and electron density distribution must be determined, considering also the propagation of errors in the evaluation procedure and the likely effect of disturbances. Using an HCN laser (lambda = 337 microns) a magnetooptical ferrite modulation technique was developed and tested which achieves the necessary precision and temporal resolution. This was verified by a single channel experiment on the French TFR Tokamak, where for the first time the Faraday rotation induced by the poloidal field was measured. Author (ESA)

N81-17915# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

MODIFIED ONE DIMENSIONAL SNOWPLOW MODEL FOR THE DESCRIPTION OF PLASMA DYNAMICS IN BELT PINCH

W. Konle Mar. 1979 53 p refs In GERMAN; ENGLISH summary

(IPF-79-2) Avail: NTIS HC A04/MF A01

In a belt pinch device, a hot, high-beta plasma is produced by the method of fast shock compression. For this heating method, the radial equilibrium depends upon the time evolution of the fast rising magnetic fields outside the plasma. A simple mathematical model for plasma compression and relaxation toward radial equilibrium in the case beta = 1, including the external electric circuit, is presented. The numerical solution for different experimental parameters leads to information on values of these parameters for reaching a radial equilibrium. For plasma compression a snowplow bounce model is used which gives the initial values for the equations of the relaxation phase. In this phase the plasma is described by three thin sheaths containing the total mass of the plasma, whose motions are damped by viscosity terms. Author (ESA)

N81-17916# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

MEASUREMENT OF TWO ION COMPONENTS IN A PLASMA BY COLLECTIVE SCATTERING

W. Kasparek, K. Hirsch, and E. Holzhauer 1979 8 p refs Submitted for publication

(IPF-79-8) Avail: NTIS HC A02/MF A01

A laser scattering experiment designed to demonstrate the predicted separation of the ion lines for two ion species (hydrogen and argon) with a large mass ratio is described. The plasma source is a stationary magnetically stabilized hydrogen arc with argon as an additive. Although the separation of the two ion components could not be observed directly since their spectral widths were nearly equal due to the different temperatures of the two ion sorts, the possibility of measuring separated ion features by collective laser scattering is confirmed. Moreover, it is possible to measure temperature differences between argon and hydrogen ions, in this case accounted for by collisional mechanisms. An apparent discrepancy between the atomic composition of the filling gas and the ratio of ion densities as derived from the scattering spectrum is also explained as due to demixing in the arc. Author (ESA)

N81-17917# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.

SPECTRALLY RESOLVED MEASUREMENTS OF THE ION FEATURE IN THE SCATTERED SPECTRUM OF A HYDROGEN PLASMA OBTAINED WITH A PERIODICALLY PULSED Nd (3+): YAG LASER

W. Kasparek 1979 84 p refs In GERMAN; ENGLISH summary

(IPF-79-9) Avail: NTIS HC A05/MF A01

Ion temperature and density in a magnetically stabilized hydrogen arc were determined from laser scattering caused by collective electron density fluctuations. A 90 deg scattering experiment was set up using a periodically pulsed Nd (3+): YAG-Laser, an IR-photomultiplier and synchronous signal detection. A spectral resolution of 0.3 A was achieved by narrowing the laser line width and by using a Fabry-Perot interferometer in combination with a monochromator as spectrometer. The data obtained from the scattering spectra agree well with results obtained by other methods. The achieved high resolution also allowed separate measurement of the ion features of two ion species with different mass, spectrally distinguished from each other. The results confirm the theoretical model of Evans. Demixing effects in an H2/A mixture as well as a temperature difference between the ion sorts are deduced. Author (ESA)

N81-17918# National Physical Lab., Teddington (England). Div. of Quantum Metrology.

DEVELOPMENT OF BARTELS' THEORY OF RADIATION FROM AN INHOMOGENEOUS LAYER AND EXTENSIONS TO THE THEORY. APPLICATIONS TO TEMPERATURE MEASUREMENTS IN INHOMOGENEOUS PLASMAS

K. C. Lapworth Feb. 1980 137 p refs

(NPL-QU-55) Avail: NTIS HC A07/MF A01

Bartels' theory of radiation from an inhomogeneous layer is reformulated in a general way for the case of a dispersion line profile. Limits of uncertainty arising in certain approximations made in the theory are shown to be readily calculable. The theory is extended to treat temperature distributions which are flatter than parabolic in addition to the parabolic temperature distributions treated by the normal Bartels' theory. Two examples of applications of the theory and its extensions are given.
Author (ESA)

N81-17919# Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes (France).
STUDY OF REACTOR PLASMA ETCHING Final Report [ETUDE DE GRAVURES PAR PLASMA REACTIF]
Michel Cathelin Oct. 1979 30 p refs In FRENCH
(Contract DGRST-78-7-2094)
(LEP-79.774.SME-692-A) Avail: NTIS HC A03/MF A01

The influence of some important parameters on etching and under-etching control of metallic layers (Mo, W-Ti) and etching of dielectric layers (SiO2, Si3N4) used in the realization of GaAs integrated circuits was determined. Etching was done in a circular-type CF4 plasma reaction chamber. The effects of varying flow rate, pressure, and of plasma dilution with N2 are reported. Modifications in the chemical reaction brought on by the addition of O2 as well as the importance of specimen temperature during etching are also discussed.
Author (ESA)

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N81-17920*# Pennsylvania State Univ., University Park. Dept. of Physics.
STUDY OF SURFACE PHENOMENA AT LOW TEMPERATURES Final Report
M. W. Cole Nov. 1980 68 p refs
(Contracts NAS7-100; JPL-955585)
(NASA-CR-163941) Avail: NTIS HC A04/MF A01 CSCL 20L

Superfluidity and nucleation concepts demonstrated by superfluid helium in finite geometries which can be tested in spaceborne experiments are discussed. Three specific problems are addressed: the liquid vapor interface, films and droplets, and ion induced clusterings.
M.G.

N81-17921# Kent Univ., Canterbury (England). Chemistry Lab.
AN INVESTIGATION OF FAST ION TRANSPORT IN SOLIDS USING CONDUCTIVITY AND NMR (FAST ION TRANSPORTATION SOLIDS) Final Report, 15 Sep. 1977 - 14 Sep. 1980
Alan V. Chadwick, David S. Hope, George Jaroskiewicz, and John H. Strange 15 Oct. 1980 90 p refs
(Grant AF-AFOSR-3427-77; AF Proj. 2303)
(AD-A093376; AFOSR-80-1337TR) Avail: NTIS HC A05/MF A01 CSCL 07/4

A study has been made of ionic transport in single crystals of LaF3 systems using electrical conductivity and N. M. R. techniques. Analysing the conductivity results in terms of Schottky disorder yield values of the defect formation and migration enthalpies as 2.12 and 0.28 eV, respectively. At low temperatures the study of oriented crystals showed the conductivity to the c-axis was twice that 1 to the c-axis. The N. M. R. relaxation time T1, T10 and T2 exhibited a complex behavior. A model was developed to interpret these results on the basis of nonequivalent F sites in the lattice. Single crystals of La1-x Srx F3-x are good F ion conductors, better than would have been expected from previous publications. A full discussion of the results has been presented, along with suggestions for future work.
GRA

N81-17922# Arizona Univ., Tucson.
THEORY OF NONLINEAR GENERATION OF X-RADIATION IN A CRYSTAL SUBJECTED TO INTENSE ELECTRON BOMBARDMENT Final Report, 1 Oct. 1979 - 30 Sep. 1980
Marlan O. Scully, J. K. McIver, and G. T. Moore Nov. 1980 31 p refs
(Grant AF-AFOSR-0035-80; AF Proj. 2305)
(AD-A093873; AFOSR-80-1346TR) Avail: NTIS HC A03/MF A01 CSCL 20/8

Several aspects of the generation of X-rays in a crystal were investigated in order to explain some of the experimental results observed by Das Gupta. Sequential excitation of planes of two-level atoms in a crystal was shown to produce stimulated line radiation whose intensity varied exponentially with the incident electron beam current. This result agreed qualitatively with the experimental data. Swept excitation was also used to explain the increase in the amount of line radiation produced at a given electron beam current when the electron's energy was changed from 8.95 KeV to 16.997 KeV. The difference between the lifetime of an excited two-level atom in free space and the lifetime of the same atom in a lattice of nonresonant two-level atoms was also investigated. The resulting difference was attributed to Bragg scattering of the emitted radiation in the crystal and the bulk properties of the material.
GRA

N81-17923# Temple Univ., Philadelphia, Pa. Dept. of Chemistry.
COOPERATIVE INTERACTIONS IN LIQUID CRYSTAL MIXTURES Final Report, 1 Oct. 1977 - 31 Oct. 1980
M. M. Labes Oct. 1980 87 p refs
(Grant DAAG29-78-G-0001)
(AD-A093790; ARO-15035.2-C) Avail: NTIS HC A05/MF A01 CSCL 07/4

The first objective of this program was to study fluorescent guest-host interactions in liquid crystals and electrooptic effects based on these interactions. Utilizing europium chelates and oligophenylenes cholesteric liquid crystal hosts, strong emission could be observed in the visible (caused by UV excitation), which could be effectively reduced by electrically switching the cholesteric texture to a homeotropic nematic texture. A simple model to account for the observed behavior was developed. Such a cholesteric electrooptic cell can also be used as a UV shutter, and by interfacing with an external passive fluorescent element, two-color displays can be achieved. Multicolor displays can be made by stacking shutter cells and passive elements. Dynamic scattering cells can be used to achieve such effects, but the contrast ratios are not high. A nematic homogeneous-homeotropic electrooptic effect can also be used as both a single color or two-color fluorescent display.
GRA

N81-17924# Stanford Univ., Calif. Solid State Electronics Lab.
PREPARATION AND PROPERTIES OF Al(x) Ga(1-4)Ar SINGLE CRYSTALS Final Report, 1 Oct. 1977 - 31 Aug. 1980
Gerald L. Pearson Sep. 1980 66 p refs
(Contract N00014-78-C-0217)
(AD-A093623) Avail: NTIS HC A04/MF A01 CSCL 20/12

This research program is divided into the following four related topics: (1) growth of Al(x)Ga(1-4)As:Cr thin semi-insulating (SI) layers by liquid phase epitaxial (LPE) techniques; (2) properties of Cr deep levels in Al(x)Ga(1-4)As:Cr single crystals; (3) investigation of the interface properties of (SI)AlxGa(1-4)As:Cr-(n)GaAs heterojunctions, and (4) construction and properties of Au-(SI)Al(x)Ga(1-4)As:Cr-(n)GaAs-(SI)GaAs:Cr MIS field effect transistor structures. Methods have been developed for reproducibly growing high quality Cr doped single crystal layers having selected values of x between 0.0 and 0.9 with specified thicknesses between 300 A and several micrometers. The results were analyzed to determine the current-transport mechanisms as well as to obtain information on the localized states and electron potential at the (SI)AlGaAs-GaAs interface. Two different insulated gate field-effect transistor structures were designed which consist of (1) a self aligned p-channel device formed by Zn diffusion and (2) an n-channel transistor formed by e-beam lithography and sulfur ion implants. Electrical measurements on the former established that a p-channel was formed and quantitative values of its properties were obtained. The latter is still under development.
GRA

N81-17925# Virginia Univ., Charlottesville. Dept. of Materials Science.

DISLOCATION CONCEPTS IN FRICTION AND WEAR

Doris Kuhlmann-Wilsdorf Dec. 1980 123 p refs Submitted for publication

(Contract N00014-76-C-1009)

(AD-A093451) Avail: NTIS HC A06/MF A01 CSCL 20/2

Using dislocation concepts, primarily as relevant to geometrical considerations, and other basic facts concerning plastic properties of crystalline materials, a number of qualitative and quantitative relationships in the area of friction and wear are developed. GRA

N81-17926# Stanford Univ., Calif. Center for Materials Research.

PREPARATION AND CHARACTERIZATION OF SINGLE CRYSTALS AND EPITAXIAL LAYERS OF SILICON CARBIDE BY MOLTEN SALT ELECTROLYSIS Final Technical Report, 15 Jul. 1979 - 14 Jul. 1980

T. H. Geballe, R. S. Feigelson, and D. Elwell Oct. 1980 32 p refs

(Contract N00014-78-C-0489; RR0210203)

(AD-A092888; SU-CMR-80-18; ONR-CR-243-026-005) Avail: NTIS HC A03/MF A01 CSCL 20/2

The electrodeposition of silicon carbide from various molten salt systems is described. The most promising system of those studied to date is the binary Li2CO3/SiO2 system with electrolysis proceeding using SiC electrodes at 1000-1050C. Considerable progress has been made towards optimizing the conditions used for electrodeposition. Zirconium or vitreous carbon crucibles are most favorable from the standpoint of the stability of the lithium carbonate against decomposition. An SiO2 concentration of 0.20 + or - 0.05 appears most favorable, with deposition proceeding at a constant potential in the region of 0.5V. Studies aimed at closer specification of optimum conditions are continuing. Electrodeposited SiC is normally polycrystalline, but there is evidence that epitaxial deposition on a single crystal alpha-SiC substrate has been achieved. This observation, if confirmed by more detailed study, would mean that the second major goal of this program has been achieved. GRA

N81-17927# Chicago Univ., Ill.

NUCLEAR TRANSMUTATION DOPING OF GaAs Final Report, 1 Jun. 1976 - 30 Jun. 1979

H. Fritzsche Oct. 1980 18 p refs

(Grant AF-AFOSR-3044-76; AF Proj. 2306)

(AD-A093217; AFOSR-80-1315TR) Avail: NTIS HC A02/MF A01 CSCL 20/8

Superior GaAs material is in great demand for high frequency and high speed GaAs devices such as Impatt diodes, Gunn diodes, field effect transistors, and avalanche photodiodes. The quality and control of impurities in GaAs material is much less advanced than in elemental semiconductors such as Si. This is partly because substitutional dopants can occupy either Ga sites or As sites and they tend to associate and cluster. We intend to develop a new method for preparing homogeneous and well controlled GaAs material. This method is nuclear transmutation doping. It has yielded superior Si and Ge semiconductor device material and should be even more successful in the case of GaAs because of the larger neutron capture cross sections and shorter radioactive decay times involved. We intend to study the doping characteristics of bulk and epitaxial layers of GaAs using nuclear transmutation doping and the resulting electrical characteristics. GRA

N81-17928# Brookhaven National Lab., Upton, N. Y.

CRYSTALLINE ELECTRIC FIELDS IN MIXED VALENT SYSTEMS

S. M. Shapiro 1980 15 p refs

(Contract DE-AC02-76CH-00016)

(BNL-28632; CONF-801134-1) Avail: NTIS HC A02/MF A01

Inelastic neutron studies of rare-earth-based mixed valent systems shown remarkably similar results: a broad quasielastic line with half width on the order of 10 meV. This width exhibits a strong temperature dependence in those systems which undergo a valence transition and is only weakly temperature dependent in those systems which show on transition. A surprising result was the absence of crystalline electric field (CEF) excitations. Recent measurements on the CE (.9-x)La(x)Th (.1) revealed the existence of CEF excitations. For x=0, the valence transition is strongly first order and occurs near T - or approximately 150 K. The inelastic spectra exhibit the typical broad quasielastic scattering. As x increases, T decreases, due to internal pressure effects and a well-defined, but broad, excitation appears near E=15 meV. This is interpreted as CEF excitation between the gamma 7 and gamma 8 levels of the Ce3(+) ion. For x=0.40, the valence transition is almost completely suppressed and the excitation becomes even sharper. Author

N81-17929# Oak Ridge National Lab., Tenn. Solid State Div.

A LEED INVESTIGATION OF (111) ORIENTED Si, Ge AND GaAs SURFACES FOLLOWING PULSED IRRADIATION

D. M. Zehner, J. R. Noonan, H. L. Davis, C. W. White, and G. W. Ownby Nov. 1980 7 p refs Presented at 1980 Mater. Res. Soc. Meeting, Boston, 16-21 Nov. 1980

(Contract W-7405-eng-26)

(CONF-801124-32) Avail: NTIS HC A02/MF A01

The low energy electron diffraction (LEED) patterns obtained from clean (111) oriented Si, Ge and GaAs single crystals subsequent to their irradiation with the output of a pulsed ruby laser in an ultra high vacuum environment are examined. The patterns suggest that metastable (lxl) surface structures are produced in the regrowth process. Conventional LEED analyses of the Si and Ge surface suggest that they terminate in registry with the bulk but that the two outermost interlayer spacings differ from those of the bulk. For the case of Si, these changes are a contraction of 25.5 + or - 2.5 percent and an expansion of 3.2 + or - 1.5 percent between the first and second and second and third layers respectively. M.G.

N81-17930# Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry.

INFORMATION THEORETIC ANALYSIS OF GAMMA-RAY MULTIPLICITIES IN DEEP INELASTIC COLLISIONS

R. D. Levine and S. G. Steadman 1979 9 p refs Prepared in cooperation with MIT, Cambridge

(Contract DE-AC02-76ER-03069; Grant AF-AFOSR-3135-77)

(DOE/ER-03069/T1) Avail: NTIS HC A02/MF A01

The results of contrained phase space approach which accounts for the magnitude and the results of the recently observed variance of gamma ray multiplicity distribution in deep inelastic collisions are reported. DOE

N81-17931# Tennessee Univ., Knoxville. Atomic Physics Group.

CONVOY ELECTRON PRODUCTION IN POLYCRYSTALLINE AND MONOCRYSTALLINE TARGETS

Sven Huldt 1980 4 p refs Prepared in cooperation with Oak Ridge National Lab.

(Contract W-7405-eng-26)

(CONF-801111-21) Avail: NTIS HC A02/MF A01

The velocity distribution electrons ejected close to the forward direction by 0.8-2 MeV/A ions traversing various solid targets, including a Au monocrystal, is measured in coincidence with emerging charge selected ions. The velocity spectrum is observed to be independent of outgoing projectile velocity and charge state for polycrystalline targets. Measurements on the Au crystal under channeling conditions show dependences on final charge state, and are tentatively explained by assuming that the main contribution to the production yield comes from the nonchanneled fraction of the ions. A simple model for the creation of the forward ejected electrons is proposed. DOE

N81-17932# Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e. V., Munich (West Germany). Inst. fuer Festkoerpertechnologie.

MEASUREMENT OF MINORITY CARRIER LIFETIME IN THIN SILICON EPITAXIAL LAYERS Final Report

Helmut Bernt, Juergen Mueller, and Hans-Peter Sphohrle Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 54 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-79-179; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11,35

A control process which measures the minority carrier lifetime

and diffusion length in thin Si epitaxial layers was developed. With the aid of a transparent MOS structure, the surface recombination velocity is controlled. A photon beam is directed on the MOS contact, adjusted from homogeneous to focused regime, while measurements in phase and amplitude of the ray are made. The RC conductance is evaluated in terms of a time constant and the distance between the beam focal point and the collector contact. Values for recombination velocity on both sides of Si thin layers (800A), low enough to measure carrier lifetime, are obtained. Author (ESA)

N81-17933# Siemens A.G., Munich (West Germany). Unternehmensbereich Bauelemente.

DEVELOPMENT OF THE ESFI-SOS TECHNOLOGY FOR LSI MOS HIGH SPEED CIRCUITS Final Report

Ekkehard Preuss and Kurt Schlueter Bonn Bundesministerium fuer Forschung und Technologie Dec. 1979 50 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-79-53; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10,30

High speed logic circuits were built using Epitaxial-Silicon-Film-on-Insulator (ESFI) Silicon-on-Sapphire (SOS) technology in order to define and extend this technique. From the basic ESFI-CMOS process, three variations were derived and realized: the self-aligned ESFION-process (ESFI with ions) for high speed logic; the low voltage process for clocks and other low power consuming circuits; and the high voltage process for high voltage applications (50 to 400 V) on chips. Sample test results verify the CMOS process concept and meet parameter objectives for circuit elements. The problems of leakage current and threshold voltage reproducibility are solved and analytically understood. High voltage test circuit results are shown for an LCD driver, a 110 V power supply, and for a galvanic separation function. Author (ESA)

N81-17934# National Bureau of Standards, Washington, D.C. National Engineering Lab.

SEMICONDUCTOR MEASUREMENT TECHNOLOGY: A FORTRAN PROGRAM FOR CALCULATING THE ELECTRICAL PARAMETERS OF EXTRINSIC SILICON Final Report

R. D. Larrabee, W. R. Thurber, and W. M. Bullis Oct. 1980 57 p refs

(PB81-115495; NBS-SP-400-63; LC-80-600158) Avail: NTIS HC A04/MF A01 CSCL 20L

A FORTRAN program is presented that solves the charge balance equation to determine the position of the Fermi level and then calculates some of the often used electrical parameters of silicon as a function of temperature. Results obtained from this program are useful in interpreting Hall effect data, determining the degree of ionization of the separate dopant states as a function of temperature, predicting the behavior of specimens when the dopant picture is intentionally (or conceptually) changed, and understanding the variations in the relative roles of the different scattering mechanisms on carrier mobility as the temperature is changed. GRA

N81-17935# Quantronix Corp., Smithtown, N.Y.

DUAL WAVELENGTH LASER THERMAL PROCESSING OF SEMICONDUCTORS

Martin G. Cohen, Kuo-Ching Liu, and Robert A. Kaplan 30 Jun. 1980 46 p refs

(Grant NSF DAR-79-17090)

(PB81-114639; NSF/RA-800162) Avail: NTIS HC A03/MF A01 CSCL 20L

A method for optimizing the annealing of ion implantation damage in semiconductors by laser irradiation is described. A solid state laser emitting high intensity pulses at 0.53 micrometers and 1.06 micrometers was used in conjunction with an optical fiber delay line to examine the annealing characteristics of an As-implanted-silicon solar cell wafer. By varying the length of fiber and thereby varying the delay between pulses of the two wavelengths, it was determined that at 25 nsec delay, the sample surface is preheated by the 0.53 micrometers radiation to provide optimal coupling for the following 1.06 micrometers radiation. These results are in agreement with a theoretical model based on melting and liquid phase epitaxial regrowth. Calculations based on the model are presented. GRA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N81-17936# Department of Energy, Bartlesville, Okla. Energy Technology Center.

THERMODYNAMICS OF ORGANIC COMPOUNDS Final Report, 1 Oct. 1979 - 30 Sep. 1980

W. D. Good, R. H. P. Thomas, B. E. Gammon, S. Lee-Bechtold, J. E. Callanan, and N. K. Smith 1980 29 p refs

(Grant AFOSR ISSA-80-0004; AF Proj. 2308)

(AD-A093087) Avail: NTIS HC A03/MF A01 CSCL 07/3

Basic and applied research have continued on the thermodynamic properties of currently used high density/high energy fuels and of pure chemical compounds that may be constituents of high energy fuels of the future. Enthalpy of combustion was measured for three compounds that are constituents of current ramjet fuels--hexacyclic exo, exo-dihydrodinorbornadiene, hexacyclic endo, endo-dihydrodinorbornadiene and exo-tetrahydrodicyclopentadiene (JP-10). Heat capacities of exo-tetrahydrodicyclopentadiene (JP-10) and RJ-6, a blend of JP-10 and the hydrogenated dimers of norbornadiene, were measured by differential scanning calorimetry. Enthalpy of combustion was measured for two pure hydrocarbons, 1,7-dimethylindan and 1,4-dimethyl-2-isobutylbenzene, that are expected to have high steric interaction energies of alkyl substituents in the ring structure, and measurements are in progress on 1-ethyl-8-methylnaphthalene and 1,6-dimethylidan. GRA

N81-17937# Department of Energy, Bartlesville, Okla. Energy Technology Center.

THERMODYNAMICS OF ORGANIC COMPOUNDS Final Technical Summary Report, 1 Oct. - 30 Sep. 1980

W. D. Good, N. K. Smith, R. H. P. Thomas, B. E. Gammon, and S. Lee-Bechtold 30 Sep. 1980 29 p refs

(Grant AFOSR ISSA-80-00004; AF Proj. 2308)

(AD-A093418; AFOSR-80-1323TR) Avail: NTIS HC A03/MF A01 CSCL 07/3

Basic and applied research have been continued on the thermodynamic properties of currently used high density/high energy fuels and of pure chemical compounds that may be constituents of high energy fuels of the future. Enthalpy of combustion was measured for three compounds that are constituents of current ramjet fuels--hexacyclic exo, exo-dihydrodinorbornadiene, hexacyclic endo, endo-dihydrodinorbornadiene and exo-tetrahydrodicyclocpentadiene (JP-10). Heat capacities of exo-tetrahydrodicyclopentadiene (JP-10) and RJ-6, a blend of JP-10 and the hydrogenated dimers of norbornadiene, were measured by differential scanning calorimetry. Enthalpy of combustion was measured for two pure hydrocarbons, 1,7-dimethylindan and 1,4-dimethyl-2-isobutylbenzene, that are expected to have high steric interaction energies of alkyl substituents in the ring structure, and measurements are in progress on 1-ethyl-8-methylnaphthalene and 1,6-dimethylindan. GRA

N81-17938# Institute of Gas Technology, Chicago, Ill.

FORMULAS FOR CALCULATING THE HEATING VALUE OF COAL AND COAL CHAR: DEVELOPMENT, TESTS, AND USES

D. M. Mason and K. Gandhi 1980 12 p refs Presented at the 180th ACS Meeting/2nd Chem. Congr. of the North Am. Continent, San Francisco, 24 Aug. 1980

(Contract DE-AC01-76ET-10251)

(CONF-800814-25) Avail: NTIS HC A02/MF A01

A five term formula for calculating the heating value of coal from its carbon, hydrogen, sulfur and ash content was

obtained by regression analysis of data on 775 samples of US coals of all ranks. The standard deviation of the calculated value from the observed value was 129 Btu/lb, compared to apparent standard deviations ranging from 178 to 229 Btu/lb obtained from other formulas. An analysis of the variance of the difference between observed and calculated values obtained with the new formulas on IGT coal data indicated that at least 77 percent is contributed by the variance of the experimental determinations; the remainder can be attributed to the effect of mineral matter and outlying experimental determinations. Application of the formula to coal oxidatively pretreated at 750 F to destroy agglomerating properties yields a bias indicating that the heat of formation is higher than expected from elemental and ash composition by about 140 Btu/lb. The formula gives satisfactory results on higher temperature HYGAS chars, and, with application of a bias correction, on pretreated coal. DOE

N81-17939# National Physical Lab., Teddington (England). Div. of Quantum Metrology.

DIFFERENCES BETWEEN THE INTERNATIONAL PRACTICAL TEMPERATURE SCALE 1968 (IPTS-68) AND THERMODYNAMIC TEMPERATURE IN THE RANGE 0 TO 1064 DEG C

P. B. Coates Jan. 1980 23 p refs

(NPL-QU-56) Avail: NTIS HC A02/MF A01

Published measurements of the deviation of The International Practical Temperature Scale (IPTS-68) from thermodynamic temperature between the ice and gold points (0 to 1064.43 C) are analyzed with (a few simple assumptions) and shown to be generally self-consistent over the whole range. The results draw attention to the need for more accurate measurements in several regions if a satisfactory revision of the IPTS is to be implemented. Author (ESA)

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N81-17940# Committee on Science and Technology (U. S. House).

THE GOVERNMENT-UNIVERSITY ACCOUNTABILITY RELATIONSHIP IN THE FIELD OF SCIENTIFIC RESEARCH

Washington GPO 1980 254 p Hearing before the Subcomm. on Sci., Res. and Technol. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., No. 110, 24 Mar. 1980

(GPO-61-323) Avail: Subcommittee on Science, Research and Technology

The financial management of Federal aid programs was reviewed. Uniform administrative requirements for grants in aid to state and local governments were discussed. Cost principles for educational institutions were examined. Coordinating indirect cost rates, audit, and audit follow up at educational institutions was described. Special emphasis was placed on cost sharing on Federal research. T.M.

N81-17941# Army Military Personnel Center, Alexandria, Va.

FACTORS IN MANAGEMENT INFORMATION SYSTEM FAILURES. M.S. Thesis. Final Report

Eldor Wynn Garrison 8 Dec. 1980 91 p refs

(AD-A093102) Avail: NTIS HC A05/MF A01 CSCL 05/2

This report surveys current literature (1970 - 1980) on factors that can adversely affect the successful completion and execution of a management information system project. Several areas are examined, including: (1) technology, (2) the human resource, (3) monetary allocations, and (4) the development of knowledge during the project life cycle. Some of the problems that exist are: (1) mismanagement of technology and failing to understand its role in MIS, (2) inadequate verbal and written communication skills, (3) insufficient support and involvement on the part of top management, (4) failure to have a definitive approach to project development, (5) inadequate documentation of requirements and specifications, (6) improper use of personnel, (7) instability to quantify intangible costs and benefits, (8) inadequate documentation of planning and development stages, and (9) a scarcity of empirical research for validating the perceived causes of failure in MIS projects. The Management Integrated Model Information, Capital and Control System (MIMIC2S) is presented as an example of the type model needed for successful development and execution of any project to include a MIS. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N81-17942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BIBLIOGRAPHY OF LEWIS RESEARCH CENTER TECHNICAL PUBLICATIONS ANNOUNCED IN 1979

May 1980 376 p

(NASA-TM-81525; E-9449-4) Avail: NTIS HC A17/MF A01 CSCL 05B

This compilation of over 1100 abstracts describes and indexes the technical reporting that resulted from the scientific and engineering work performed and managed by the Lewis Research Center in 1979. All the publications were announced in the 1979 issues of STAR (Scientific and Technical Aerospace Reports) and/or IAA (International Aerospace Abstracts). Research reports, journal articles, conference presentations, patents and patent applications, and theses are included. Subject, author, corporate source, contract number, and report number indexes are provided. A.R.H.

N81-17943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BIBLIOGRAPHY OF LEWIS RESEARCH CENTER TECHNICAL PUBLICATIONS ANNOUNCED IN 1978

May 1979 367 p

(NASA-TM-79162; E-9449-3) Avail: NTIS HC A16/MF A01 CSCL 05B

All the publications were announced in the 1978 issues of STAR (Scientific and Technical Aerospace Reports) and/or IAA (International Aerospace Abstracts). Included are research reports, journal articles, conference presentations, patents and patent applications, and theses. T.M.

N81-17944*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE 1979 AMES RESEARCH CENTER PUBLICATIONS: A CONTINUING BIBLIOGRAPHY

1979 319 p

(NASA-TM-81257; A-8431) Avail: NTIS HC A14/MF A01 CSCL 05B

This bibliography lists formal NASA publications, journal articles, books, chapters of books, patents, and contractor reports issued by Ames Research Center which were indexed by Scientific and Technical Aerospace Reports, Limited Scientific and Technical Aerospace Reports, and International Aerospace Abstracts in 1979. Citations are arranged by directorate, type of publication, and NASA accession numbers. Subject, Personal Author, Corporate Source, Contract Number, and Report/Accession Number Indexes are provided. Author

N81-17945# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences.
THE CONSEQUENCES OF THE UNIQUENESS ASSUMPTION FOR RELATIONAL DATABASES Technical Report, Apr. 1980 - Mar. 1981
Arron Beller Apr. 1980 33 p refs
(Contract N00014-75-C-0452)
(AD-A093399; Rept-80-03-13) Avail: NTIS HC A03/MF A01 CSCL 09/2

Much of the work on relational databases that deals with data dependencies makes a uniqueness (or universal relation) assumption. It has been recognized that this assumption is problematic; nevertheless it is necessary for the axiomatic approach taken in many papers on the theory of relational databases. We will describe the problem, investigate some of the solutions put forward and suggest a new solution. Many of the problems remain intractable within the realm of 'classical' relational databases and restrictions must be placed on the use of FDs. An automated method is presented that searches for violations of the uniqueness assumption. GRA

N81-17946# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences.
DATA BASE DESIGN FOR DECISION SUPPORT
Eric K. Clemons Oct. 1980 25 p refs
(Contract N00014-75-C-0462; NR Proj. 049-272)
(AD-A093442) Avail: NTIS HC A02/MF A01 CSCL 05/2

A satisfactory user interface is essential for a decision support system to gain acceptance, and system performance is an important component of the user interface. Several suggestions for data base design are presented to improve system performance and response time, and thus to improve the user interface. GRA

N81-17947# Dayton Univ., Ohio.
COMPUTER MANIPULATION OF LABORATORY DATA Technical Report, May 1978 - May 1980
George W. Fultz and Terry L. Green Wright-Patterson AFB, Ohio AFWAL Aug. 1980 23 p refs
(Contract F33615-78-C-5127; AF Proj. 2421)
(AD-A093531; AFWAL-TR-80-4106) Avail: NTIS HC A02/MF A01 CSCL 09/2

Programs have been written for the CDC 6600 computer in Extended FORTRAN. The data input for the programs is entered remotely using a CRT terminal. It is possible with the remote terminal to observe data before plotting. The data may then be edited and drawn into plots at a remote plotting site. Operational use has shown the CDC 6600 computer to be a valuable instrument and time saving device for the manipulation of large numbers of data points. GRA

N81-17948# National Bureau of Standards, Washington, D.C.
COMPUTER SCIENCE AND TECHNOLOGY: DATA BASE DIRECTIONS. THE CONVERSION PROBLEM Final Report
John L. Berg, ed, Daniel B. Magraw, Milt Bryce, and James H. Burrows Sep. 1980 107 p refs Workshop held at Fort Lauderdale, Fla., 1-3 Nov. 1977 Sponsored in part by Association for Computing Machinery, New York
(PB81-114076; NBS-SP-500-64; LC-80-600129) Avail: NTIS HC A06/MF A01 CSCL 05B

The impact of conversion on data base systems is addressed. Data base conversion is explored from four prespectives: management, previous experience, standards, and system technology. GRA

N81-17949# National Bureau of Standards, Washington, D.C. National Measurement Lab.
SUMMARY OF ON-LINE OR INTERACTIVE PHYSICO-CHEMICAL NUMERICAL DATA SYSTEMS Final Report
Joseph Hilsenrath Oct. 1980 29 p
(PB81-115511; NBS-TN-1122) Avail: NTIS HC A03/MF A01 CSCL 05B

A brief description is given of 51 interactive physico-chemical numerical data systems, most of which are on-line on international computer networks. The systems are listed under five headings: those useful for identification of substances from spectroscopic data; those providing thermodynamic and transport properties of pure components and mixtures; those which perform metallurgical calculations and draw phase diagrams; systems producing complete tables of thermodynamic properties of individual substances; and those for chemical process simulation, optimization, and design. References to published descriptions of the systems, where they exist, are also given. GRA

N81-17950# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
MANUAL OF DOCUMENTATION PRACTICES APPLICABLE TO DEFENCE-AEROSPACE SCIENTIFIC AND TECHNICAL INFORMATION. VOLUME 3
S. C. Schuler, ed. Oct. 1980 191 p refs 4 Vol.
(AGARD-AG-235-Vol-3; ISBN-92-835-1373-8) Avail: NTIS HC A09/MF A01

Various aspects of information retrieval are described including the principles of post coordinate indexing, examples of feature and edge punched card systems, the use of computers to produce various types of indexes, and the role of dial up on-line systems. Information dissemination practices are outlined and a survey of procedures used by a number of international technical information centers is given. The preparation and reproduction of research and development publications in both paper and microfilm media are described. The factors involved in setting up production facilities are discussed. For individual titles, see N81-17951 through N81-17953.

N81-17951# Royal Aircraft Establishment, Farnborough (England).
INFORMATION RETRIEVAL
Tom Norton *In* AGARD Manual of Doc. Pract. Appl. to Defence-Aerospace Sci. and Tech. Inform. Vol. 3 Oct. 1980 42 p refs (For primary document see N81-17950 08-82)
Avail: NTIS HC A09/MF A01

After a brief historical overview of information retrieval (IR), a model of an IR system is presented and described. The characteristics of conventional indexing systems are reviewed and shortcomings noted. The principles of postcoordinate indexing systems and examples of feature card and edge punched card systems with suggested applications are described. Problems of vocabulary control are discussed and suggestions on thesaurus construction and presentation are given. The use of computers to produce various types of indexes (KWIC, KWOC, and SLIC) is briefly described. The features of computerized dial up on-line information systems are discussed: equipment, telecommunications, file organization, search preparation and strategy, staff training, advantages and limitations of such systems, and future developments. An appendix outlines the principal features of specialized information centers. Author

N81-17952# Rome Air Development Center, Griffiss AFB, N.Y.
DISSEMINATION PRACTICES
Fred S. Dyer *In* AGARD Manual of Doc. Pract. Appl. to Defence-Aerospace Sci. and Tech. Inform., Vol. 3 Oct. 1980 72 p (For primary document see N81-17950 08-82)
Avail: NTIS HC A09/MF A01

The dissemination of scientific and technical (S&T) information to the scientific user community is discussed. An overview of the area is presented followed by discussions of initial and secondary distribution. The need for automated support of the processes is described. Included as an appendix are the results of survey responses from a number of national and international technical information centers. These responses detail charters, data bases, practices, and operations of the responding S&T information centers. Most of the S&T information points surveyed are concerned with unclassified, unrestricted material. The exceptions were usually those which interfaced with a well defined user community readily subject to registration and control, and able to demonstrate a need to know such as contractors working on defense contracts. E.D.K.

N81-17953# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
MICROFORM SYSTEMS AND REPROGRAPHY
Peter Rolls *In its* Manual of Doc. Pract. Appl. to Defence-Aerospace Sci. and Tech. Inform., Vol. 3 Oct. 1980 72 p refs (For primary document see N81-17950 08-82)
Avail: NTIS HC A09/MF A01

The preparation and reproduction of research and development publications are discussed. Technical details of reprographic and

microfilm processes are outlined in order to show the main factors involved in setting up publication facilities. The requirements for equipment and staff resources are discussed and cost elements are identified in broad terms. The application of computer output on microfilm is outlined and a review of the practical aspects of quality control for publications in both paper and microfilm media is included. E.D.K.

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N81-17954# California Univ., Berkeley. Operations Research Center.
A FUNCTIONAL INEQUALITY, WITH APPLICATIONS TO PRODUCTION THEORY
King-Tim Mak Oct. 1980 18 p refs
(Contract N00015-76-C-0134; Grant NSF MCS-77-16054)
(AD-A093785; ORC-80-22) Avail: NTIS HC A02/MF A01 CSCL 05/3

A functional inequality is used in the formulation of a regularity condition on the scaling of production. This functional inequality is characterized and then applied: deduce a law of diminishing return; and derive a bound on the growth of an open economy. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N81-17955# Committee on Science and Technology (U. S. House).
NASA AUTHORIZATION, 1982 (PROGRAM REVIEW), VOLUME 2
Washington GPO 1980 513 p Hearings before the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 96th Congr., 2nd Sess., no. 164, 16-18 Sep. 1980
(GPO-69-646) Avail: Subcommittee on Space Science and Applications

The problems of cost, performance, and schedule which can affect the NASA budget program performance were examined. Changes in the fiscal year 1981 budget plan are discussed. Special emphasis was placed on the schedule of the Space Transportation System flight 1 and problems it has encountered. T.M.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

N81-17956*# National Aeronautics and Space Administration, Washington, D. C.
NASA TECH BRIEFS INDEX 1979
1979 108 p
(NASA-SP-5021(21)) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 05B

Approximately 593 announcements of new technology derived from the research and development activities of NASA are presented. Emphasis is placed on information considered likely to be transferrable across industrial, regional, or disciplinary lines. Subject matter covered includes: electronic components and circuits; electronic systems; physical sciences; materials; life sciences' mechanics; machinery; fabrication technology; and mathematics and information sciences. J.M.S.

N81-17957*# National Aeronautics and Space Administration, Washington, D. C.
SPINOFF 1980 Annual Report
James J. Haggerty Apr. 1980 147 p Original contains color illustrations
(NASA-TM-82233) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, BWI Airport, Md. 21240 CSCL 05B

Products which trace their origins to technology developed to meet the goals of NASA's aerospace programs are discussed. The technology utilization is viewed from the stand point that each of spinoffs contributes some measure of benefit to the national productivity or lifestyle. The mechanisms that NASA employs to foster technology utilization are discussed and special emphasis is placed on the provision of assistance to agencies interested in exploiting the benefit potential of satellite remote sensing technology. T.M.

N81-17958*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE MARSHALL CENTER: ITS PLACE IN NASA
[1981] 31 p refs
(NASA-TM-82254) Avail: NTIS HC A03/MF A01 CSCL 05A

The organizational structure and facilities available at the Marshall Space Flight Center are described and the role of the Center in NASA program management is demonstrated in a review of the Center's past history and current development projects. Particular attention is given to space shuttle and the space transportation system; the preparation of experiments and management of Spacelab missions; and the development of the space telescope. Energy related activities discussed include the automatic guidance and control of the longwall shearing machine for coal extraction, systems for the solar heating and cooling of buildings, and the design of the solar power satellite. Products developed by Center personnel highlighted include the power factor controller to reduce electrical consumption by motors and the image enhancement process being used to restore early historical photographs. A free flying solar power source to increase mission duration of the orbiter and its payloads; techniques for the orbital assembly of large space structures; facilities for materials processing in space; the orbit transfer vehicle, solar electric propulsion systems; and the preparation of science and applications payloads are also described. A.R.H.

N81-17959# National Highway Traffic Safety Administration, Washington, D. C.
AUTOMOTIVE FUEL ECONOMY PROGRAM Annual Report
Jan. 1980 79 p
(DOT-HS-805-279; ARTTC-4) Avail: NTIS HC A05/MF A01

An energy outlook is presented that focuses on petroleum demand and supply, and the effects of fuel economy standards on petroleum savings. Passenger car and light truck fuel economy activities are summarized including sales patterns and trends. Other fuel economy related activities are discussed and include compliance activities, the gas guzzler tax, legislative recommendations, and voluntary fuel economy programs. T.M.

N81-17960# Army Mobility Equipment Research and Development Command, Fort Belvoir, Va.
BASELINE TESTS OF THE GE-100 CENTENNIAL ELECTRIC PASSENGER VEHICLE Final Technical Memo
Edward J. Dowgiallo, Jr., Ivan R. Snellings, and William H. Blake Sep. 1980 105 p
(Contract EC-77-A-31-1042)
(AD-A093737; MERADCOM-2308) Avail: NTIS HC A06/MF A01 CSCL 13/6

The GE-100 Centennial electric vehicle is a one of a kind prototype. Results of performance tests, speed, acceleration, gradeability, range, and efficiencies are presented. The GE-100 is powered by eighteen 6 volt lead-acid batteries driving a 16.3 kW d.c. series motor through an EV-1C controller. The

motor drives the wheels through a chain drive to the differential. No regenerative braking was provided. GRA

N81-17961# Army Mobility Equipment Research and Development Command, Fort Belvoir, Va.
VERIFICATION TEST OF JET INDUSTRIES ELECTRA-VAN 1000P
Edward J. Dowgiallo, Jr., Ivan R. Snellings, and William H. Blake Oct. 1980 32 p
(Contract EC-77-A-31-1042)
(AD-A093738; MERADCOM-2311) Avail: NTIS HC A03/MF A01 CSCL 13/6

The Electra-Van 1000P is a Chrysler Corp. pickup truck which has been converted to an electric vehicle. It was tested as part of a Department of Energy demonstration program. The Electra-Van 1000P performance test results are presented. The 1000P is powered by 24 6 volt lead acid batteries through an SCR Controller to a 37-hp electric motor. It has a manual 4 speed transmission and front disc and rear drum brakes. It does not have regenerative braking. GRA

N81-17962# Gellman Research Associates, Inc., Jenkintown, Pa.
THE RELATIONSHIP OF GENERAL AVIATION-ASSOCIATED PRODUCTS AND SERVICES TO THE NATIONAL ECONOMY, 1977 Final Report
Frank Berardino, Jerome Bentley, Gloria Dank, Frederick Tiffany, and Richard Abrams 8 Sep. 1980 220 p refs
(Contract DOT-FA78WA-4218)
(AD-A093369) Avail: NTIS HC A10/MF A01 CSCL 05/3

This study addresses two questions: What were the contributions made by the general aviation (GA) industry to the Gross National Product (GNP) and Gross National Income (GNI) in 1977? What were the aggregate resource savings and consumer benefits (to the economy) attributable to the use of general aviation in 1977? To answer the first question requires measuring the economic activity in the general aviation industry in the year 1977. Answering the second question requires estimating economic losses that would have occurred in the absence of the general aviation industry in 1977. Because these questions are different, two separate sets of methodologies were developed to answer them. GRA

N81-17963# California Univ., Livermore. Lawrence Livermore Lab.
EVALUATION OF A HYBRID FLYWHEEL/BATTERY PROPULSION SYSTEM FOR ELECTRIC VEHICLES
E. P. Cornell, F. G. Turnbull, and T. M. Barlow 16 Oct. 1980 9 p refs Prepared in cooperation with G.E. Co., Schenectady, N.Y.
(Contract W-7405-eng-48)
(UCRL-15259) Avail: NTIS HC A02/MF A01

The system consists of a steel flywheel coupled to a high-speed inductor motor/alternator fed by a load-commutated inverter/rectifier which does not utilize a shaft position sensor for inverter control. Computer control is used to provide component as well as overall system control and data acquisition. This flywheel energy storage system was laboratory tested over the SAE J227a Schedules D, C, and B driving cycles, using a laboratory simulation of an electric vehicle drive. Results show that maximum benefit occurs on the Schedule D cycle for which the overall system was optimized. From these tests, recommendations for additional improvements to this propulsion system are presented. DOE

N81-17964# North Texas State Univ., Denton. Inst. of Applied Sciences.
OXIDATION OF WATER SUPPLY REFRACTORY SPECIES BY OZONE WITH ULTRAVIOLET RADIATION Final Report, Sep. 1976 - Feb. 1980
William H. Glaze, Gary R. Peyton, Francis Y. Huang, Jimmie L. Burleson, and Priscilla C. Jones Aug. 1980 323 p refs
(Grant EPA-R-804640)
(PB81-107104; EPA-600/2-80-110) Avail: NTIS HC A14/MF A01 CSCL 13B

The model compounds chloroform, bromo-dichloromethane, tetrachloroethylene and 2,2',4,4',6,6'-hexachlorobiphenyl were treated with ozone/UV as well as UV and ozone individually in both highly purified water and lake water. Kinetic rate expressions which express the dependence of the reaction rate on ozone dose rate, UV intensity and substrate concentration were developed. The trihalomethane formation potential of a natural lake water was monitored as a function of ozone/UV treatment time. Products resulting from the ozone/UV treatment of some model compounds and lake water were studied. GRA

N81-17965# M and I, Inc., Fort Collins, Colo.
EVALUATION OF OPERATION AND MAINTENANCE FACTORS LIMITING MUNICIPAL WASTE WATER TREATMENT PLANT PERFORMANCE, PHASE 2 Final Report, Oct. 1977 - Apr. 1979
Bob A. Hegg, Kerwin L. Rakness, James R. Schultz, and Larry D. DeMers Aug. 1980 171 p refs
(Contract EPA-68-03-2572)
(PB81-112864; EPA-600/2-80-129) Avail: NTIS HC A08/MF A01 CSCL 13B

The identified highest ranking causes of limited plant performance reflect an inability of in plant personnel to optimize process control and the performance of existing facilities. Deficiencies in design features also ranked high. The Composite Correction Program (CCP) was introduced and demonstrated. This approach to improving the performance of existing facilities was conducted at selected facilities. Areas of special evaluation include aerator and clarifier design, sludge production in activated sludge plants, aerobic digestion operation, reference materials used in treatment plants, operator time and tasks before and after a CCP, and the effects of toxic substances on well operated treatment facilities. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N81-17966*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SYSTEMS LEVEL FEASIBILITY STUDY FOR THE DETECTION OF EXTRA-SOLAR PLANETS. VOLUME 1: INFRARED INTERFEROMETER (IRIS) KNOWN AS THE STANFORD CONCEPT Final Report
Jun. 1979 153 p
(Contract NAS2-10030)
(NASA-CR-152253; LMSC-D676424-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 03A

A sensor system for the direct detection of extrasolar planets from an Earth orbit is evaluated: a spinning, infrared interferometer (IRIS). It is shuttle deployed, free flying, requires no on-orbit assembly and no reservicing over a design life of five years. The sensor concept and the mission objectives are reviewed, and the performance characteristics of a baseline sensor for standard observation conditions are derived. A baseline sensor design is given and the enabling technology discussed. Cost and weight estimates are performed; and a schedule for an IRIS program including technology development and assessment of risk are given. Finally, the sensor is compared with the apodized visual telescope sensor (APOTS) proposed for the same mission. The major conclusions are: that with moderate to strong technology advances, particularly in the fields of long life cryogenics, dynamical control, mirror manufacturing, and optical alignment, the detection of a Jupiter like planet around a Sunlike star at a distance of 30 light years is feasible, with a 3 meter aperture and an observation time of 1 hour. By contrast, major and possibly unlikely breakthroughs in mirror technology are required for APOTS to match this performance. M.G.

N81-17967*# Delaware Univ., Newark.
THEORETICAL STUDIES OF THE RS CANNUM VENATICORUM STARS Annual Report, 1 Jan. - 31 Dec. 1980
Dermott J. Mullan 4 Mar. 1981 51 p refs
(Grant NAGw-5)
(NASA-CR-163959) Avail: NTIS HC A04/MF A01 CSCL 03A

Four areas of research were investigated: chromospheric modelling; starspot modelling; supersonic transition locus (STL) crossing; and STL crossing and T Tauri phenomena. Relationships among these areas of research are presented. Stellar structure and mass ejection for these stars were examined along with chromospheric analysis. T.M.

N81-17968# Arizona State Univ., Tempe.
NEW INSTABILITY STRIP FOR HOT DEGENERATES
Sumner G. Starrfield, Arthur N. Cox, and Stephen W. Hodson 1980 7 p refs Presented at the Intern. Astron. Union Colloq. 58 on Stellar Hydrodyn., Los Alamos, N.Mex., Aug. 1980 Prepared in cooperation with LASL
(Contract W-7405-eng-36)
(LA-UR-80-3135; CONF-800872-16) Avail: NTIS HC A02/MF A01

A new kind of variable star, designated as PG1159-035 is distinguished not only by the complete lack of hydrogen in its spectrum but also by an effective temperature that exceeds 80,000 K. The star does not fall near any of the known regions of instability in the HR diagram which suggests that the instability mechanism will not be helium and hydrogen ionization as in the Cepheid variables. The more unusual compositions were examined in order to discover the cause of the instability in PG1159-035. DOE

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N81-17969# Los Alamos Scientific Lab., N. Mex.
SOLAR-TYPE PROTOSTARS
M. J. Newman, Karl-Heinz A. Winkler, and Michael J. Newman 1980 8 p refs Presented at the Intern. Astron. Union Colloq. 58 on Stellar Hydrodyn., Los Alamos, N. Mex., 12-15 Aug. 1980
(Contract W-7405-eng-36)
(LA-UR-80-2872; CONF-800872-7) Avail: NTIS HC A02/MF A01

The formation of a 1 M/sub 0 protostar in spherical symmetry was followed in time dependent hydrodynamics with a detailed description of the equation of state and a careful treatment of radiative transport. The comparison of the dynamic evolution with observation was made in terms of the Hertzsprung-Russell diagram. It was found that the evolution following from Larson's initial condition produces quantitatively and qualitatively better agreement than that following from the initial condition of Hayashi, including the first appearance of the object as an infrared source. Of particular importance for a correct physical understanding of the formation process is an adequate description of the accretion shock. Pressure ionization and electrodegeneracy effects are of increasing importance for the internal structure of lower mass objects. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N81-17970*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA USER'S NOTE: APOLLO SEISMOLOGICAL INVESTIGATIONS
Robert W. Vostreys Oct. 1980 33 p refs
(NASA-TM-82280; NSSDC/WDC-A-R&S-80-11) Avail: NTIS HC A03/MF A01 CSCL 03B

Seismological objectives and equipment used in the passive seismic, active seismic, lunar seismic profiling, and the lunar gravimeter experiments conducted during Apollo 11, 12, 14, 15, 16, and 17 missions are described. The various formats in which the data form these investigations can be obtained are listed an an index showing the NSSDC identification number is provided. Tables show manned lunar landing missions, lunar seismic network statistics, lunar impact coordinate statistics, detonation masses and times of EP's, the ALSEP (Apollo 14) operational history; compressed scale playout tape availability, LSPE coverage for one lunation, and experimenter interpreted events types. A.R.H.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N81-17971*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE LOCKHEED OSO-8 PROGRAM. ANALYSIS OF DATA FROM THE MAPPING X-RAY HELIOMETER EXPERIMENT Final Report, 24 Jun. 1975 - 31 Aug. 1980
L. W. Acton, C. J. Wolfson, D. W. Datlowe, J. M. Mosher, D. T. Roethig, and K. L. Smith 30 Sep. 1980 151 p refs
(Contract NAS5-22411)
(NASA-CR-160087; LMSC-D766866) Avail: NTIS HC A08/MF A01 CSCL 03B

The final report describes the extent of the analysis effort, and other activities associated with the preservation and documentation of the data set are described. The main scientific results, which are related to the behavior of individual solar activity regions in the energy band 1.5 - 15 keV, are summarized, and a complete bibliography of publications and presentations is given. Copies of key articles are also provided. T.M.

N81-17972# Naval Research Lab., Washington, D. C.
A MECHANISM FOR HEATING THE SOLAR CORONA
David L. Book 3 Dec. 1980 10 p refs
(AD-A093181; NRL-MR-4408) Avail: NTIS HC A02/MF A01 CSCL 03/2

The high temperatures measured in the solar corona are explained in terms of heating which results from the work done on the plasma by expanding magnetic flux. This theory, which invokes no wave deposition or ohmic heating processes, is consistent with the strongly magnetized, highly variable nature of the solar atmosphere. GRA

N81-17973*# Maryland Univ., College Park. Dept of Physics and Astronomy.
IONIZATION STATES OF HEAVY ELEMENTS OBSERVED IN THE 1974 MAY 14-15 ANOMALOUS SOLAR PARTICLE EVENT
L. S. Ma Sung, G. Gloeckler, C. Y. Fan (Max-Planck-Inst. fuer Physik und Astrophysik, Munich), and D. Hovestadt (Arizona Univ., Tucson) [1981] 15 p refs
(Contract NAS5-11063; Grant NGR-21-002-224)
(NASA-CR-163932) Avail: NTIS HC A02/MF A01 CSCL 03B

The charge states of heavy ions accelerated in the (3)He-Fe rich solar particle event of 1974 May 14-15 are determined using data from the Interplanetary Monitoring Platform-8. In addition to Fe(+11,12) both O(+5) and Fe(+16,17,18) are also present suggesting variations in coronal temperatures over a range from approximately 400,000 to 5,000,000 K. The presence of O(+5) and Fe(+16-18) may be explained by a resonant plasma heating mechanism proposed to account for the enhancements of (3)He and Fe. M.G.

N81-17974# Michigan State Univ., East Lansing. Dept. of Astronomy and Astrophysics.

SOLAR ATMOSPHERIC DYNAMICS Final Report, 1 Mar. 1977 - 30 Sep. 1979
Robert F. Stein Hanscom AFB, Mass. AFGL May 1980 72 p refs
(Contract F19628-77-C-0068; AF Proj. 2311)
(AD-A092910; AFGL-TR-80-0208) Avail: NTIS HC A04/MF A01 CSCL 03/2

We have studied the heating of the solar chromosphere and transition region by acoustic waves. We find they are incapable of transporting sufficient energy through the chromosphere to heat the transition region and corona. We are developing a radiative fluid dynamic computer code to study acoustic heating of the chromosphere and the effect of acoustic waves on line profiles. In order to study heating by other types of wave motions we have analyzed the wave vector surface of the Magneto-Acoustic-Gravity Waves and are developing a 'modal' computer code to study their propagation and dissipation. GRA

N81-17975*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
PLASMA WAVES ASSOCIATED WITH ENERGETIC PARTICLES STREAMING INTO THE SOLAR WIND FROM THE EARTH'S BOW SHOCK ***Progress Report for period ending Jul. 1980***
R. R. Anderson, G. K. Parks, T. E. Eastman, D. A. Gurnett, and L. A. Frank 8 Dec. 1980 61 p refs Submitted for publication
(Contracts NAS5-20079; NAS5-20093; NAS5-20094; N00014-76-C-0016; Grants NGL-16-001-002; NGL-16-001-043)
(NASA-CR-163053; AD-A094010; U-of-Iowa-80-40) Avail: NTIS HC A04/MF A01 CSCL 04/1

In the upstream solar wind, three dominant types of plasma waves are observed associated with energetic particle streams coming from the Earth's bow shock: ion-acoustic waves, electron plasma oscillations, and whistler-mode waves. The ion-acoustic waves occur simultaneously with either ion beams or a dispersed ion population in the energy range from approximately 0.5 to greater than 45 keV. These short-wavelength electrostatic waves are very impulsive and the peak amplitudes increase with increasing ion flux and at spatial gradients in the energetic ion densities. The electon plasma oscillations are long-wavelength nearly monochromatic electrostatic wave which are closely correlated with the flux of low energy electrons, especially in the 0.2 - 1.5 keV range. In the presence of only enhanced electron fluxes, the average amplitudes of the electron plasma oscillations approach the peak amplitudes. GRA

N81-17976# Naval Research Lab., Washington, D. C.
THE IONOSPHERIC RESPONSE TO SOLAR FLARES. 1: EFFECTS OF APPROXIMATIONS OF SOLAR FLARE EUV FLUXES
Elaine S. Oran and John T. Mariska 16 Jan. 1981 23 p refs (RR0330244)
(AD-A093745; NRL-MR-4428) Avail: NTIS HC A02/MF A01 CSCL 03/2

SOLRAD and many other satellite systems have provided a large data base showing the time-dependent behavior of broad and band solar fluxes in the X-ray and EUV spectral regions. These bands are broad in the sense that one band may contain many ionospherically important spectral lines. We present results of tests performed to determine how this information can be best be used to predict the effects of a solar flare on the ionosphere. Our approach has been to first adopt a model of the spectral line and continuum enhancements based on a synthesis of many types of flare observations. This detailed spectral model is used in a time-dependent ionosphere model to calculate the response of the electron and ion density profiles. Then the spectral model is mathematically filtered to show how it would appear to the SOLRAD EUV detectors, and this degraded information is used in the ionosphere model. Comparison of the two ionosphere shows that the two spectra produces changes in the total electron content in the ionosphere that differ by only a few percent. More significant changes which occur in the individual species densities are described. GRA

N81-17977# National Bureau of Standards, Washington, D.C. National Measurement Lab.
SUNSPOT CYCLE SIMULATION USING A NARROWBAND GAUSSIAN PROCESS
J. A. Barnes, H. Sargent, III, and P. V. Tryon Sep. 1980 25 p refs
(PB81-115503; NBS-TN-1022) Avail: NTIS HC A02/MF A01 CSCL 03B

The square of a narrowband Gaussian process is used to simulate sunspot cycles at computer speeds. The method is appealing because: (1) the model is extremely simple yet its physical basis, a simple resonance, is a widely occurring natural phenomenon and (2) the model recreates practically all of the features of the observed sunspot record. In particular, secular cycles and recurring extensive minima are characteristic of narrowband Gaussian processes. Additionally, the model lends itself to limited prediction of sunspot cycles. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

No abstracts in this category.

99 GENERAL

N81-17978# Aerospace Medical Div., Brooks AFB, Tex.
AIR FORCE TECHNICAL OBJECTIVE DOCUMENT. AEROSPACE MEDICAL DIVISION FISCAL YEAR 1982 ***Final Report***
1980 47 p Supersedes AMD-TR-79-1
(AD-A093383; AMD-TR-80-1; AMD-TR-79-1) Avail: NTIS HC A03/MF A01 CSCL 05/8

This TOD describes the planning methodology used within AMD laboratories: seven technology areas to achieve our technical goals. Specifically, efforts are directed in the biotechnology program to man's adaptability, survivability, and performance capabilities within his operational environment. This research and development of AMD's functions is accomplished as disciplinary work by teams of biomedical scientists, engineers and physical scientists within the Air Force laboratories and the industrial and academic research and development communities. GRA

N81-17979# Air Force Academy, Colo. Dept. of Aeronautics.
AIR FORCE ACADEMY AERONAUTICS DIGEST, SPRING/SUMMER 1980 ***Final Report***
A. M. Higgins, ed., E. J. Jumper, ed., James M. Kempf, ed., and Barbara J. Gregory, ed. Oct. 1980 103 p refs
(AD-A093378; USAFA-TR-80-17) Avail: NTIS HC A06/MF A01 CSCL 01/3

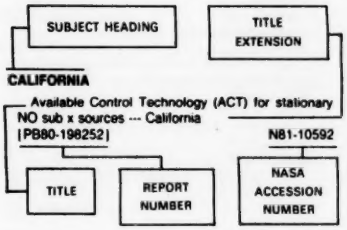
Partial contents: aerodynamic effects of spanwise grooves on a symmetrical airfoil: comparison of time-dependent rotation matrix transformation methods; further evaluation of a Gluhareff pressure jet; a low-cost point-focusing distributed solar concentrator; and measurement of very large flow angles with non-nulling seven-hole probes. GRA

N81-17980# Royal Society, London (England).
UNITED KINGDOM REPORT ON SPACE RESEARCH, 1979-1980
1980 68 p refs Presented at 23rd COSPAR Meeting, Budapest, 2-14 Jun. 1980 Sponsored by Brit. Natl. Comm. on Space Res.
Avail: NTIS HC A04/MF A01

Research undertaken using instruments flown on balloons, rockets and satellites, observations of satellites from the ground, and related theoretical studies are outlined. Participation in NASA and ESA programs is indicated. Included are activities in UV,

X-ray, IR and gamma ray astronomy, solar physics, cosmic ray research, atmospheric physics (Earth and other planets) as well as lunar and meteoric studies are reported. Satellite orbit analysis, magnetospheric and ionospheric research, and remote sensing are mentioned. Author (ESA)

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

A

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Evaluation of alternative procedures for atmospheric absorption adjustments during noise certification. Volume 2: Computer program [AD-A093267] N81-17853

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Microwave acoustics handbook. Volume 4: Bulk wave velocities: Numerical data [AD-A092957] N81-17847

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Evaluation of alternative procedures for atmospheric absorption adjustments during noise certification. Volume 3: Tables of atmospheric absorption losses --- aircraft noise [AD-A093144] N81-17848

ACOUSTIC IMPEDANCE
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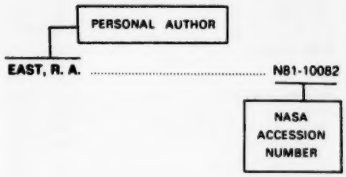

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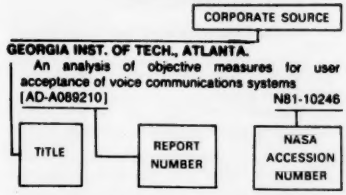

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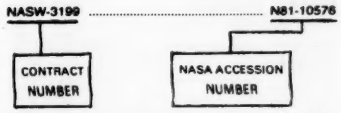

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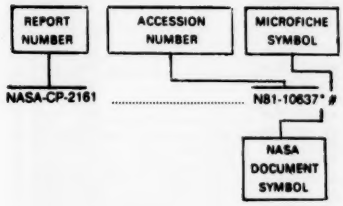

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